

A Compilation of Data of Interest
at > 10 GeV Proton Accelerators

D.E. Lobb and A.K.C. Chan

TRIUMF

Physics Department
University of Victoria

1. Introduction

This report presents computed values of production cross sections and decay kinematics for secondary particles produced by primary proton beams with kinetic energies of 10 and 15 GeV. (Production cross section results for 12, 18 and 24 GeV protons are presented in Lobb¹.) The formulae used are not discussed in detail; the reader is referred to the list of references at the back of this report. We also present a table of the fraction of an initial pion or kaon beam that survives a specified drift distance and the resulting enhancement of the π/κ rates.

2. Zero degree production cross sections

Yamamoto²) has suggested a formula for the number of secondary particles produced into one steradian solid angle and one GeV/c momentum interval by one interacting proton:

$$\frac{d^2N}{d\Omega dp} = \frac{p^2}{U} \left(\frac{C}{227} \right) \left[1 - \frac{1}{U_{op}} \left[U - \frac{p_p}{U_{op} + U_p} \cdot p \right] \right]^D \quad 2.1$$

where U_{op} , p_p , U_p are the rest energy (GeV), laboratory momentum (GeV/c) and laboratory total energy (GeV) of the incident proton; p and U are the laboratory momentum (GeV/c) and laboratory total energy (GeV) of the secondary particle; C and D are fitting parameters tabulated in Yamamoto²).

The results of Eq. 2.1 can be compared to the Sanford-Wang function^{3,4)}:

$$f = A p_p^B \left[1 - \frac{p}{p_p} \right] \exp \left[- \frac{C p^D}{E p_p} \right] \quad 2.2$$

where p_p is the incident proton laboratory momentum (GeV/c), p is the secondary particle laboratory momentum (GeV/c), and A, B, C, D are fitting parameters. (C and D do not have the same numerical values as in the Yamamoto formula.) Values of the parameters are quoted in Yamamoto²⁾.

For low momenta, the Sanford-Wang results are obtained by kinematic reflection of higher momentum results⁵⁾. (This is discussed in detail in Yamamoto²⁾ and complete formulae will be presented in Lobb⁶⁾.) For 10 GeV protons, kinematic reflection applies to zero degree production for momenta below 0.322 GeV/c for charged pions, below 1.140 GeV/c for charged kaons, below 1.149 GeV/c for neutral kaons, and below 2.166 GeV/c for protons and antiprotons. For 15 GeV protons the corresponding values are 0.395, 1.396, 1.407 and 2.653 GeV/c respectively.

While some doubt exists about the absolute values of the results, they should still be useful for comparing shapes of the secondary particle spectra. The reader is referred to Yamamoto²⁾ for comparisons of the KEK experimental data to the Yamamoto and Sanford-Wang formulae.

In Tables 2.1 to 2.10 we present the Sanford-Wang and Yamamoto results for 10 and 15 GeV protons producing $\bar{p}, \pi^+, \pi^-, \kappa^+$ and κ^- . (Since no experimental data are available for κ^0 production, it can be assumed that the κ^0 production cross sections are the same as the κ^+ production cross sections.)

In Table 2.11 we present the π^+/κ^- and π^-/κ^- production ratios, calculated using the values in Tables 2.3 to 2.10.

3. Sanford-Wang Angular Dependence

The complete Sanford-Wang formula^{3,4)} for the number of secondary particles produced at a laboratory angle θ (radian) with respect to the incident proton direction into one steradian solid angle and one GeV/c momentum interval is

$$\frac{d^2N}{d\Omega dp} = A p^B \left(1 - \frac{p}{p_p}\right) \cdot \exp\left(-\frac{C p^D}{E p_p}\right) \cdot \exp[-F\theta(p - G p_p \cos^H \theta)] \quad 3.1$$

with the complete set of fitting parameters tabulated in Yamamoto²⁾. In Tables 3.1 to 3.10 we present the ratio of the complete Sanford-Wang cross section (including kinematic reflection if appropriate) for a particular value of the laboratory production angle to the result obtained at zero degree production angle. It will be noticed that in some cases a ratio greater than unity is obtained; these results may be due to inadequate correction of the original experimental data for absorption in the production target. However, the results should give a reasonable indication of the fraction of the secondary particles that are contained within a given angular cone.

4. $\kappa^0 \rightarrow \pi^+ + \pi^-$ decay kinematics

Laboratory momenta and laboratory decay angles for the various κ^0 momenta are presented in Figs 4.1, 4.2 and 4.3. The points plotted on each contour represent center of momentum decay angles at a spacing of 20° . Center of momentum decay angles (θ^*) and laboratory decay angles (θ) are measured with respect to the direction of the κ^0 momentum in the laboratory.

In Table 4.1 we present the parameters for forward decay in the center of mass ($\theta^* = 0^\circ$), the most probable decay in the center of mass ($\theta^* = 90^\circ$), and for backward decay in the center of mass ($\theta^* = 180^\circ$). (Backward decay in the center of mass is calculated for $\theta^* = 179.9999^\circ$ since $\theta^* = 180^\circ$ results in an ambiguous result for θ .)

The formulae used are those presented by Williams⁷).

5. $\kappa^\pm \rightarrow \pi^\pm + \pi^0$ decay kinematics

Laboratory momenta and laboratory decay angles for the charged pion are presented in Figs. 5.1, 5.2 and 5.3. The charged pion results for center of momentum decay angles of 0° , 90° and $\sim 180^\circ$ are presented in Table 5.1.

Laboratory momenta and laboratory decay angles for the neutral pion are presented in Figs. 5.4, 5.5 and 5.6. The neutral pion results for charged pion center of momentum decay angles of 0° , 90° and $\sim 180^\circ$ (neutral pion center of momentum decay angles of 180° , 90° and $\sim 0^\circ$ respectively) are presented in Table 5.2.

6. $\kappa^\pm \rightarrow \mu^\pm + \nu$ decay kinematics

Laboratory momenta and laboratory decay angles for the charged muon are presented in Figs. 6.1, 6.2 and 6.3. Results for center of momentum decay angles of 0° , 90° and $\sim 180^\circ$ are presented in Table 6.1. Results for the neutrino are presented in Figs. 6.4, 6.5 and 6.6 and Table 6.2. (In Table 6.2, the table headings of 0° , 90° and $\sim 180^\circ$ are muon decay angles; the corresponding neutrino decay angles are 180° , 90° and $\sim 0^\circ$.)

7. $\pi^\pm \rightarrow \mu^\pm + \nu$ decay kinematics

The laboratory momenta and laboratory decay angle of the muons are presented in Figs. 7.1, 7.2 and 7.3, and Table 7.1. Results for the neutrino are presented in Figs. 7.4, 7.5 and 7.6, and Table 7.2. (In Table 7.2, the column headings of center of momentum decay angle of 0° , 90° and $\sim 180^\circ$ refer to the muon, the corresponding center of momentum decay angles for the neutrino are 180° , 90° and $\sim 0^\circ$.)

8. Enhancement of the π/K ratio by a drift

The decay length for a pion at rest is 7.804 m; for a charged kaon at rest it is 3.709 m. In Tables 8.1 to 8.3 we present F_π , F_K , and F_π/F_K where F represents the fraction of particles surviving a drift length L :

$$F = \exp [- L/\beta\gamma d] \quad 8.1$$

where d is the decay length at rest, $\beta = (\text{particle velocity})/c$, and $\gamma = [1 - \beta^2]^{-1/2}$.

REFERENCES

- 1) D.E. Lobb, Sanford-Wang results for 12, 18 and 24 GeV protons, VPN-82-5 (1982)
- 2) A. Yamamoto, Study in Low Energy Intense Kaon Beam, KEK-81-13 (1981)
- 3) J.R. Sanford and C.L. Wang, BNL 11279 and BNL 11479 (1967)
- 4) C.L. Wang, Phys. Rev. Lett. 25 (1970) 1068
- 5) D. Bereley, Proceedings of the Summer Study Meeting on Kaon Physics and Facilities, BNL 50579 (1976) 257
- 6) D.E. Lobb, Cloud pions, VPN-82-6 (1982)
- 7) W.S.C. Williams in W. Galbraith and W.S.C. Williams, editors, High Energy and Nuclear Physics Data Handbook, 2nd edition, Rutherford High Energy Laboratory (1964)

momentum
cf

Zero Degree Production
($\text{sr}\cdot\text{GeV}/c$)⁻¹

Table 2.1

Table 2.1

Kinetic energy of the incident proton is 15.0 GeV

Momentum of		Zero degree Production (sr.GeV/c) ⁻¹	
secondary anti-proton <GeV/c>	kinematic reflection	Sanford-Wang's formula with	Yamamoto's formula
		kinematic reflection	formula
0.350	0.346774E-07	0.24E680E-07	0.24E680E-07
0.400	0.107412E-06	0.9E486E-07	0.9E486E-07
0.450	0.2E8824E-06	0.297036E-06	0.297036E-06
0.500	0.693037E-06	0.77E330E-06	0.77E330E-06
0.550	0.1E0C9C4E-06	0.177830E-05	0.177830E-05
0.600	0.3E021884E-06	0.3E561E-05	0.3E561E-05
0.650	0.9E2456E-06	0.1E055C1E-04	0.1E055C1E-04
0.700	0.1E2371CE-04	0.197872E-04	0.197872E-04
0.750	0.2E5261E-04	0.3E3163E-04	0.3E3163E-04
0.800	0.384391E-04	0.45E611E-04	0.45E611E-04
0.850	0.557043E-04	0.6E2CCE-04	0.6E2CCE-04
0.900	0.78C232E-03	0.907736E-03	0.907736E-03
0.950	0.1060257E-03	0.121776E-03	0.121776E-03
1.000	0.14C257E-03	0.1E233E-03	0.1E233E-03
1.050	0.41E077E-03	0.4E233E-03	0.4E233E-03
1.100	0.858147E-03	0.8E3939E-03	0.8E3939E-03
1.150	0.142677E-02	0.143933E-02	0.143933E-02
1.200	0.20E377E-02	0.2C1802E-02	0.2C1802E-02
1.250	0.272373E-02	0.25C472E-02	0.25C472E-02
1.300	0.3377E-02	0.3E3429E-02	0.3E3429E-02
1.350	0.381827E-02	0.3E3429E-02	0.3E3429E-02
1.400	0.39C735E-02	0.371634E-02	0.371634E-02
1.450	0.3694354E-02	0.367795E-02	0.367795E-02
1.500	0.3E0279E-02	0.354694E-02	0.354694E-02
1.550	0.301766E-02	0.3133E9E-02	0.3133E9E-02
1.600	0.245493E-02	0.261705E-02	0.261705E-02
1.650	0.190758E-02	0.2C4E31E-02	0.2C4E31E-02
1.700	0.141877E-02	0.158833E-02	0.158833E-02
1.750	0.10137E-02	0.1E387E-02	0.1E387E-02
1.800	0.696339E-03	0.8E4581E-03	0.8E4581E-03
1.850	0.461490E-03	0.36C409E-03	0.36C409E-03
1.900	0.29E342E-03	0.224184E-03	0.224184E-03
1.950	0.182726E-03	0.1E3383E-03	0.1E3383E-03
2.000	0.63362E-04	0.339919E-04	0.339919E-04

Table 2.2

Kinetic energy of the incident proton is 10.0 GeV			
Momentum of		Zero Degree Production (sr.GeV/c) ⁻¹	
secondary positive pion		Sanford-Nag's formula with kinematic reflection	
<GeV/c>		Yamamoto's formula	
0.350	0.44563CE+CC	0.29298EE+CC	0.29298EE+CC
0.400	0.572007EE+CC	0.346718EE+CC	0.346718EE+CC
0.450	0.6120073EE+CC	0.3909220EE+CC	0.3909220EE+CC
0.500	0.649398EE+CC	0.433744EE+CC	0.433744EE+CC
0.550	0.684418EE+CC	0.4774662EE+CC	0.4774662EE+CC
0.600	0.717278EE+CC	0.5177488EE+CC	0.5177488EE+CC
0.650	0.748144EE+CC	0.5559788EE+CC	0.5559788EE+CC
0.700	0.777155EE+CC	0.5920364EE+CC	0.5920364EE+CC
0.750	0.804065EE+CC	0.626358CE+CC	0.626358CE+CC
0.800	0.8300652EE+CC	0.6583210EE+CC	0.6583210EE+CC
0.850	0.854152EE+CC	0.6832295EE+CC	0.6832295EE+CC
0.900	0.876768EE+CC	0.71198894	0.71198894
0.950	0.897982EE+CC	0.73	0.73
1.000	0.917856EE+CC	0.766038EE+CC	0.766038EE+CC
1.050	0.938945EE+CC	0.795599EE+CC	0.795599EE+CC
1.100	0.958342EE+CC	0.825591EE+CC	0.825591EE+CC
1.150	0.975446EE+CC	0.855591EE+CC	0.855591EE+CC
1.200	0.990533EE+CC	0.8838631	0.8838631
1.250	0.1009533EE+CC	0.913092EE+CC	0.913092EE+CC
1.300	0.102866EE+CC	0.943092EE+CC	0.943092EE+CC
1.350	0.105078EE+CC	0.973092EE+CC	0.973092EE+CC
1.400	0.107374EE+CC	0.993092EE+CC	0.993092EE+CC
1.450	0.109666EE+CC	0.993092EE+CC	0.993092EE+CC
1.500	0.111937EE+CC	0.993092EE+CC	0.993092EE+CC
1.550	0.114197EE+CC	0.993092EE+CC	0.993092EE+CC
1.600	0.116448EE+CC	0.993092EE+CC	0.993092EE+CC
1.650	0.118698EE+CC	0.993092EE+CC	0.993092EE+CC
1.700	0.120948EE+CC	0.993092EE+CC	0.993092EE+CC
1.750	0.123198EE+CC	0.993092EE+CC	0.993092EE+CC
1.800	0.125448EE+CC	0.993092EE+CC	0.993092EE+CC
1.850	0.127698EE+CC	0.993092EE+CC	0.993092EE+CC
1.900	0.129948EE+CC	0.993092EE+CC	0.993092EE+CC
1.950	0.132198EE+CC	0.993092EE+CC	0.993092EE+CC
2.000	0.134448EE+CC	0.993092EE+CC	0.993092EE+CC

Table 2.3

Kinetic energy of the incident frctn is 15.0 Gev			
Mcmentur	Zero	Degree	Frducticn
cf	(sr.Gev/c) ⁻¹		
secenary	Sanford-Wang's		Paramctc's
positive fcn	fctrula		
<Gev/c>	kinematic	reflection	formula
0.33E+00	0.371513E+00	0.371513E+00	0.25E+00
0.43E+00	0.4769CCE+00	0.4769CCE+00	0.311823E+00
0.44E+00	0.5E3604E+00	0.5E3604E+00	0.36E+00
0.50E+00	0.62E462E+00	0.62E462E+00	0.41E+00
0.50E+00	0.666997E+00	0.666997E+00	0.46C0CCE+00
0.60E+00	0.7E54447E+00	0.7E54447E+00	0.506424E+00
0.60E+00	0.742E02E+00	0.742E02E+00	0.5E14E+00
0.70E+00	0.77E68E+00	0.77E68E+00	0.59E048E+00
0.70E+00	0.810168E+00	0.810168E+00	0.63E03E+00
0.80E+00	0.841978E+00	0.841978E+00	0.678296E+00
0.80E+00	0.87E441E+00	0.87E441E+00	0.717952E+00
0.90E+00	0.9C1546E+00	0.9C1546E+00	0.756447E+00
0.9E+00	0.929463E+00	0.929463E+00	0.7536709E+00
1.0E+00	0.9E1E61E+00	0.9E1E61E+00	0.8229709E+00
1.0E+00	1.09E04E+00	1.09E04E+00	0.864584E+00
1.1E+00	1.1E662E+00	1.1E662E+00	0.9C1E2E+00
1.1E+00	1.12E872E+00	1.12E872E+00	0.9C1E383E+00
1.2E+00	0.13147CE+00	0.13147CE+00	0.1E1E17E+00
1.2E+00	0.13560CE+00	0.13560CE+00	0.1E1E17E+00
1.2E+00	0.138443E+00	0.138443E+00	0.1344807E+00
1.3E+00	0.140113E+00	0.140113E+00	0.1414472E+00
1.3E+00	0.14044CE+00	0.14044CE+00	0.1463354E+00
1.3E+00	0.139313E+00	0.139313E+00	0.14E6E23E+00
1.3E+00	0.137457E+00	0.137457E+00	0.1514423E+00
1.4E+00	0.134963E+00	0.134963E+00	0.1513925E+00
1.4E+00	0.128392E+00	0.128392E+00	0.14E6
1.5E+00	0.112021E+00	0.112021E+00	0.1E2E+00
1.5E+00	0.11C949E+00	0.11C949E+00	0.1E3E+00
1.5E+00	0.1010E+00	0.1010E+00	0.1E3E+00
1.6E+00	0.9C5C81E+00	0.9C5C81E+00	0.1E3E+00
1.6E+00	0.808146E+00	0.808146E+00	0.1E3E+00
1.7E+00	0.71018E+00	0.71018E+00	0.1E3E+00
1.8E+00	0.61770E+00	0.61770E+00	0.1E3E+00
1.8E+00	0.53CCE+00	0.53CCE+00	0.1E3E+00
1.9E+00	0.4501E+00	0.4501E+00	0.1E3E+00
1.9E+00	0.3777E+00	0.3777E+00	0.1E3E+00
1.9E+00	0.371312E+00	0.371312E+00	0.1E3E+00

Table 2.4

Kinetic energy of the incident proton is 10.0 GeV

Momentum of secondary negative pion <GeV/c>	Zero Degree Production (sr.GeV/c) ⁻¹	
	Sanford-Wang's formula with kinematic reflection	Yamamoto's formula
0.30	0.380271E+00	0.216962E+00
0.35	0.450793E+00	0.259242E+00
0.40	0.479684E+00	0.299290E+00
0.45	0.506026E+00	0.337077E+00
0.50	0.533014E+00	0.372640E+00
0.55	0.555229E+00	0.406048E+00
0.60	0.572266E+00	0.437371E+00
0.65	0.591412E+00	0.466687E+00
0.70	0.608675E+00	0.494073E+00
0.75	0.624556E+00	0.519600E+00
0.80	0.639159E+00	0.543343E+00
0.85	0.652533E+00	0.565368E+00
0.90	0.664812E+00	0.585741E+00
0.95	0.675999E+00	0.604529E+00
1.00	0.686170E+00	0.621795E+00
1.10	0.723357E+00	0.687231E+00
1.20	0.741297E+00	0.722694E+00
1.30	0.743515E+00	0.734009E+00
1.40	0.732966E+00	0.726196E+00
1.50	0.712129E+00	0.703566E+00
1.60	0.683172E+00	0.669841E+00
1.70	0.648012E+00	0.628154E+00
1.80	0.608347E+00	0.581174E+00
1.90	0.565669E+00	0.531118E+00
2.00	0.521280E+00	0.479789E+00
2.10	0.476292E+00	0.428681E+00
2.20	0.431641E+00	0.376926E+00
2.30	0.346266E+00	0.286836E+00
2.40	0.269506E+00	0.208034E+00
2.50	0.203648E+00	0.144194E+00
2.60	0.149392E+00	0.951014E-01
2.70	0.106311E+00	0.592870E-01
2.80	0.732669E-01	0.345999E-01
2.90	0.487635E-01	0.186463E-01
3.00	0.311969E-01	0.909520E-02
3.10	0.190360E-01	0.389715E-02
3.20	0.109274E-01	0.139836E-02
3.30	0.574369E-02	0.386986E-03
3.40	0.259148E-02	0.703518E-04

Table 2.5

Kinetic energy of the incident proton is 15.0 GeV

momentum of secondary negative pion <GeV/c>	Sanford-fang's formula with kinematic reflection	Zero degree Production (sr.GeV/c) ⁻¹	Yamamoto's formula
0.350	0.02161E+00	237695E+00	237695E+00
0.350	0.394818E+00	319422E+00	319422E+00
0.450	0.469240E+00	3161186E+00	3161186E+00
0.450	0.5177816E+00	31934717E+00	31934717E+00
0.550	0.544363E+00	4033948E+00	4033948E+00
0.550	0.569183E+00	4482035E+00	4482035E+00
0.650	0.5922411E+00	5186613E+00	5186613E+00
0.650	0.6144223E+00	5537633E+00	5537633E+00
0.750	0.6344733E+00	6194482E+00	6194482E+00
0.750	0.6672276E+00	6194482E+00	6194482E+00
0.850	0.6894467E+00	6613941E+00	6613941E+00
0.850	0.7056943E+00	679517E+00	679517E+00
0.950	0.721013E+00	7341E+00	7341E+00
1.050	0.756225E+00	849103E+00	849103E+00
1.150	0.840706E+00	9386773E+00	9386773E+00
1.150	0.871461E+00	106404E+00	106404E+00
1.250	0.890559E+00	106404E+00	106404E+00
1.250	0.899990E+00	1065171E+00	1065171E+00
1.350	0.899990E+00	1065171E+00	1065171E+00
1.350	0.899990E+00	1065171E+00	1065171E+00
1.450	0.899990E+00	1065171E+00	1065171E+00
1.450	0.899990E+00	1065171E+00	1065171E+00
1.550	0.899990E+00	1065171E+00	1065171E+00
1.550	0.899990E+00	1065171E+00	1065171E+00
1.650	0.899990E+00	1065171E+00	1065171E+00
1.650	0.899990E+00	1065171E+00	1065171E+00
1.750	0.899990E+00	1065171E+00	1065171E+00
1.750	0.899990E+00	1065171E+00	1065171E+00
1.850	0.899990E+00	1065171E+00	1065171E+00
1.850	0.899990E+00	1065171E+00	1065171E+00
1.950	0.899990E+00	1065171E+00	1065171E+00
1.950	0.899990E+00	1065171E+00	1065171E+00
2.050	0.899990E+00	1065171E+00	1065171E+00
2.050	0.899990E+00	1065171E+00	1065171E+00
2.150	0.899990E+00	1065171E+00	1065171E+00
2.150	0.899990E+00	1065171E+00	1065171E+00
2.250	0.899990E+00	1065171E+00	1065171E+00
2.250	0.899990E+00	1065171E+00	1065171E+00
2.350	0.899990E+00	1065171E+00	1065171E+00
2.350	0.899990E+00	1065171E+00	1065171E+00
2.450	0.899990E+00	1065171E+00	1065171E+00
2.450	0.899990E+00	1065171E+00	1065171E+00
2.550	0.899990E+00	1065171E+00	1065171E+00
2.550	0.899990E+00	1065171E+00	1065171E+00
2.650	0.899990E+00	1065171E+00	1065171E+00
2.650	0.899990E+00	1065171E+00	1065171E+00
2.750	0.899990E+00	1065171E+00	1065171E+00
2.750	0.899990E+00	1065171E+00	1065171E+00
2.850	0.899990E+00	1065171E+00	1065171E+00
2.850	0.899990E+00	1065171E+00	1065171E+00
2.950	0.899990E+00	1065171E+00	1065171E+00
2.950	0.899990E+00	1065171E+00	1065171E+00
3.050	0.899990E+00	1065171E+00	1065171E+00
3.050	0.899990E+00	1065171E+00	1065171E+00
3.150	0.899990E+00	1065171E+00	1065171E+00
3.150	0.899990E+00	1065171E+00	1065171E+00
3.250	0.899990E+00	1065171E+00	1065171E+00
3.250	0.899990E+00	1065171E+00	1065171E+00
3.350	0.899990E+00	1065171E+00	1065171E+00
3.350	0.899990E+00	1065171E+00	1065171E+00
3.450	0.899990E+00	1065171E+00	1065171E+00
3.450	0.899990E+00	1065171E+00	1065171E+00
3.550	0.899990E+00	1065171E+00	1065171E+00
3.550	0.899990E+00	1065171E+00	1065171E+00
3.650	0.899990E+00	1065171E+00	1065171E+00
3.650	0.899990E+00	1065171E+00	1065171E+00
3.750	0.899990E+00	1065171E+00	1065171E+00
3.750	0.899990E+00	1065171E+00	1065171E+00
3.850	0.899990E+00	1065171E+00	1065171E+00
3.850	0.899990E+00	1065171E+00	1065171E+00
3.950	0.899990E+00	1065171E+00	1065171E+00
3.950	0.899990E+00	1065171E+00	1065171E+00
4.050	0.899990E+00	1065171E+00	1065171E+00
4.050	0.899990E+00	1065171E+00	1065171E+00
4.150	0.899990E+00	1065171E+00	1065171E+00
4.150	0.899990E+00	1065171E+00	1065171E+00
4.250	0.899990E+00	1065171E+00	1065171E+00
4.250	0.899990E+00	1065171E+00	1065171E+00
4.350	0.899990E+00	1065171E+00	1065171E+00
4.350	0.899990E+00	1065171E+00	1065171E+00
4.450	0.899990E+00	1065171E+00	1065171E+00
4.450	0.899990E+00	1065171E+00	1065171E+00
4.550	0.899990E+00	1065171E+00	1065171E+00
4.550	0.899990E+00	1065171E+00	1065171E+00
4.650	0.899990E+00	1065171E+00	1065171E+00
4.650	0.899990E+00	1065171E+00	1065171E+00
4.750	0.899990E+00	1065171E+00	1065171E+00
4.750	0.899990E+00	1065171E+00	1065171E+00
4.850	0.899990E+00	1065171E+00	1065171E+00
4.850	0.899990E+00	1065171E+00	1065171E+00
4.950	0.899990E+00	1065171E+00	1065171E+00
4.950	0.899990E+00	1065171E+00	1065171E+00
5.050	0.899990E+00	1065171E+00	1065171E+00
5.050	0.899990E+00	1065171E+00	1065171E+00
5.150	0.899990E+00	1065171E+00	1065171E+00
5.150	0.899990E+00	1065171E+00	1065171E+00
5.250	0.899990E+00	1065171E+00	1065171E+00
5.250	0.899990E+00	1065171E+00	1065171E+00
5.350	0.899990E+00	1065171E+00	1065171E+00
5.350	0.899990E+00	1065171E+00	1065171E+00
5.450	0.899990E+00	1065171E+00	1065171E+00
5.450	0.899990E+00	1065171E+00	1065171E+00
5.550	0.899990E+00	1065171E+00	1065171E+00
5.550	0.899990E+00	1065171E+00	1065171E+00
5.650	0.899990E+00	1065171E+00	1065171E+00
5.650	0.899990E+00	1065171E+00	1065171E+00
5.750	0.899990E+00	1065171E+00	1065171E+00
5.750	0.899990E+00	1065171E+00	1065171E+00
5.850	0.899990E+00	1065171E+00	1065171E+00
5.850	0.899990E+00	1065171E+00	1065171E+00
5.950	0.899990E+00	1065171E+00	1065171E+00
5.950	0.899990E+00	1065171E+00	1065171E+00
6.050	0.899990E+00	1065171E+00	1065171E+00
6.050	0.899990E+00	1065171E+00	1065171E+00
6.150	0.899990E+00	1065171E+00	1065171E+00
6.150	0.899990E+00	1065171E+00	1065171E+00
6.250	0.899990E+00	1065171E+00	1065171E+00
6.250	0.899990E+00	1065171E+00	1065171E+00
6.350	0.899990E+00	1065171E+00	1065171E+00
6.350	0.899990E+00	1065171E+00	1065171E+00
6.450	0.899990E+00	1065171E+00	1065171E+00
6.450	0.899990E+00	1065171E+00	1065171E+00
6.550	0.899990E+00	1065171E+00	1065171E+00
6.550	0.899990E+00	1065171E+00	1065171E+00
6.650	0.899990E+00	1065171E+00	1065171E+00
6.650	0.899990E+00	1065171E+00	1065171E+00
6.750	0.899990E+00	1065171E+00	1065171E+00
6.750	0.899990E+00	1065171E+00	1065171E+00
6.850	0.899990E+00	1065171E+00	1065171E+00
6.850	0.899990E+00	1065171E+00	1065171E+00
6.950	0.899990E+00	1065171E+00	1065171E+00
6.950	0.899990E+00	1065171E+00	1065171E+00
7.050	0.899990E+00	1065171E+00	1065171E+00
7.050	0.899990E+00	1065171E+00	1065171E+00
7.150	0.899990E+00	1065171E+00	1065171E+00
7.150	0.899990E+00	1065171E+00	1065171E+00
7.250	0.899990E+00	1065171E+00	1065171E+00
7.250	0.899990E+00	1065171E+00	1065171E+00
7.350	0.899990E+00	1065171E+00	1065171E+00
7.350	0.899990E+00	1065171E+00	1065171E+00
7.450	0.899990E+00	1065171E+00	1065171E+00
7.450	0.899990E+00	1065171E+00	1065171E+00
7.550	0.899990E+00	1065171E+00	1065171E+00
7.550	0.899990E+00	1065171E+00	1065171E+00
7.650	0.899990E+00	1065171E+00	1065171E+00
7.650	0.899990E+00	1065171E+00	1065171E+00
7.750	0.899990E+00	1065171E+00	1065171E+00
7.750	0.899990E+00	1065171E+00	1065171E+00
7.850	0.899990E+00	1065171E+00	1065171E+00
7.850	0.899990E+00	1065171E+00	1065171E+00
7.950	0.899990E+00	1065171E+00	1065171E+00
7.950	0.899990E+00	1065171E+00	1065171E+00
8.050	0.899990E+00	1065171E+00	1065171E+00
8.050	0.899990E+00	1065171E+00	1065171E+00
8.150	0.899990E+00	1065171E+00	1065171E+00
8.150	0.899990E+00	1065171E+00	1065171E+00
8.250	0.899990E+00	1065171E+00	1065171E+00
8.250	0.899990E+00	1065171E+00	1065171E+00
8.350	0.899990E+00	1065171E+00	1065171E+00
8.350	0.899990E+00	1065171E+00	1065171E+00
8.450	0.899990E+00	1065171E+00	1065171E+00
8.450	0.899990E+00	1065171E+00	1065171E+00
8.550	0.899990E+00	1065171E+00	1065171E+00
8.550	0.899990E+00	1065171E+00	1065171E+00
8.650	0.899990E+00	1065171E+00	1065171E+00
8.650	0.899990E+00	1065171E+00	1065171E+00
8.750	0.899990E+00	1065171E+00	1065171E+00
8.750	0.899990E+00	1065171E+00	1065171E+00
8.850	0.899990E+00	1065171E+00	1065171E+00
8.850	0.899990E+00	1065171E+00	1065171E+00
8.950	0.899990E+00	1065171E+00	1065171E+00
8.950	0.899990E+00	1065171E+00	1065171E+00
9.050	0.899990E+00	1065171E+00	1065171E+00
9.050	0.899990E+00	1065171E+00	1065171E+00
9.150	0.899990E+00	1065171E+00	1065171E+00
9.150	0.899990E+00	1065171E+00	1065171E+00
9.250	0.899990E+00	1065171E+00	1065171E+00
9.250	0.899990E+00	1065171E+00	1065171E+00
9.350	0.899990E+00	1065171E+00	1065171E+00
9.350	0.899990E+00	1065171E+00	1065171E+00
9.450	0.899990E+00	1065171E+00	1065171E+00
9.450	0.899990E+00	1065171E+00	1065171E+00
9.550	0.899990E+00	1065171E+00	1065171E+00
9.550	0.899990E+00	1065171E+00	1065171E+00
9.650	0.899990E+00	1065171E+00	1065171E+00
9.650	0.899990E+00	1065171E+00	1065171E+00
9.750	0.899990E+00	1065171E+00	1065171E+00
9.750	0.899990E+00	1065171E+00	1065171E+00
9.850	0.899990E+00	1065171E+00	1065171E+00
9.850	0.899990E+00	1065171E+00	1065171E+00
9.950	0.899990E+00	1065171E+00	1065171E+00
9.950	0.899990E+00	1065171E+00	1065171E+00
10.050	0.899990E+00	1065171E+00	1065171E+00
10.050	0.899990E+00	1065171E+00	1065171E+00

Table 2.6

Kinetic energy of the incident proton is 10.0 GeV

Momentum of secondary positive kaon <GeV/c>	Zero Degree Production [sr.GeV/c] ⁻¹	
	Sanford-Wang's formula with kinematic reflection	Yamanaka's formula
0.30	0.420065E-02	0.355984E-02
0.35	0.557064E-02	0.512129E-02
0.40	0.778041E-02	0.693177E-02
0.45	0.990618E-02	0.895016E-02
0.50	0.122269E-01	0.111338E-01
0.55	0.147247E-01	0.134424E-01
0.60	0.173854E-01	0.158393E-01
0.65	0.201977E-01	0.182931E-01
0.70	0.231531E-01	0.207771E-01
0.75	0.262456E-01	0.232689E-01
0.80	0.294711E-01	0.257504E-01
0.85	0.328271E-01	0.282069E-01
0.90	0.363126E-01	0.306265E-01
0.95	0.399274E-01	0.329995E-01
1.00	0.436729E-01	0.353187E-01
1.25	0.577920E-01	0.459399E-01
1.50	0.638220E-01	0.547448E-01
1.75	0.690399E-01	0.617033E-01
2.00	0.735212E-01	0.669152E-01
2.25	0.773093E-01	0.705302E-01
2.50	0.804253E-01	0.727147E-01
2.75	0.828732E-01	0.738338E-01
3.00	0.846445E-01	0.734507E-01
3.25	0.857226E-01	0.723205E-01
3.50	0.860837E-01	0.703886E-01
3.75	0.857038E-01	0.677908E-01
4.00	0.845612E-01	0.646525E-01
4.50	0.759417E-01	0.572122E-01
5.00	0.722836E-01	0.488798E-01
5.50	0.619852E-01	0.403182E-01
6.00	0.498731E-01	0.320481E-01
6.50	0.371641E-01	0.244593E-01
7.00	0.252532E-01	0.178177E-01
7.50	0.153619E-01	0.122787E-01
8.00	0.818383E-02	0.788395E-02
8.50	0.371651E-02	0.464544E-02
9.00	0.138952E-02	0.241461E-02
9.50	0.406822E-03	0.104503E-02
10.00	0.852800E-04	0.333457E-03

Table 2.7

Kinetic energy of the incident proton is 15.0 GeV			
Momentum	Zero	Degree Production	
cf		(sr.GeV/c) ⁻¹	
secondary	Sanford-Kang's	Yamamoto's	
positive kaon	formula		
<GeV/c>	kinematic with reflecticn	formula	
0.35	3.69167E-02	3.71302E-02	3.71302E-02
0.40	5.15944E-02	5.37116E-02	5.37116E-02
0.45	6.69333E-02	7.33107E-02	7.33107E-02
0.50	8.69099E-02	9.44310E-02	9.44310E-02
0.55	0.107711E-01	0.118709E-01	0.118709E-01
0.60	0.128760E-01	0.144055E-01	0.144055E-01
0.65	0.151771E-01	0.170716E-01	0.170716E-01
0.70	0.175648E-01	0.202337E-01	0.202337E-01
0.75	0.201007E-01	0.226386E-01	0.226386E-01
0.80	0.227302E-01	0.249379E-01	0.249379E-01
0.85	0.254445E-01	0.283677E-01	0.283677E-01
0.90	0.282274E-01	0.341177E-01	0.341177E-01
0.95	0.311533E-01	0.394461E-01	0.394461E-01
1.00	0.341133E-01	0.444444E-01	0.444444E-01
1.05	3.71996E-01	4.97999E-01	4.97999E-01
1.10	4.03722E-01	5.52852E-01	5.52852E-01
1.15	4.37087E-01	6.04432E-01	6.04432E-01
1.20	4.71332E-01	6.61443E-01	6.61443E-01
1.25	5.07897E-01	7.13439E-01	7.13439E-01
1.30	5.44005E-01	7.61244E-01	7.61244E-01
1.35	5.87133E-01	8.04705E-01	8.04705E-01
1.40	6.32882E-01	8.44444E-01	8.44444E-01
1.45	6.86144E-01	8.81111E-01	8.81111E-01
1.50	7.49200E-01	9.11111E-01	9.11111E-01
1.55	8.22277E-01	9.37999E-01	9.37999E-01
1.60	9.03722E-01	9.61111E-01	9.61111E-01
1.65	9.91996E-01	9.81111E-01	9.81111E-01
1.70	0.107322E+00	0.100000E+00	0.100000E+00
1.75	0.110122E+00	0.114641E+00	0.114641E+00
1.80	0.111142E+00	0.118819E+00	0.118819E+00
1.85	0.111027E+00	0.108611E+00	0.108611E+00
1.90	0.107444E+00	0.951512E+00	0.951512E+00
1.95	0.102622E+00	0.866114E+00	0.866114E+00
2.00	0.938427E+00	0.752286E+00	0.752286E+00
2.05	0.872292E+00	0.662218E+00	0.662218E+00
2.10	0.772527E+00	0.597711E+00	0.597711E+00
2.15	0.661700E+00	0.510000E+00	0.510000E+00
2.20	0.546000E+00	0.427231E+00	0.427231E+00
2.25	0.432000E+00	0.336600E+00	0.336600E+00
2.30	0.32572E+00	0.281229E+00	0.281229E+00

Table 2.8

10-C Gey

McMentur cf	Zero degree (sr.Gev/c) ⁻¹	Sanford-Wang's formula with kinematic reflection	Yamamoto's formula
0.350	0.375645E-02	0.350224E-02	0.350224E-02
0.400	0.135011E-02	0.135023E-02	0.135023E-02
0.450	0.203714E-02	0.203739E-02	0.203739E-02
0.500	0.367533E-02	0.367539E-02	0.367539E-02
0.550	0.464836E-02	0.464839E-02	0.464839E-02
0.600	0.567226E-02	0.567229E-02	0.567229E-02
0.650	0.675352E-02	0.675355E-02	0.675355E-02
0.700	0.788892E-02	0.788895E-02	0.788895E-02
0.750	0.849331E-02	0.849334E-02	0.849334E-02
0.800	0.114433E-02	0.114433E-02	0.114433E-02
0.850	0.126444E-02	0.126444E-02	0.126444E-02
0.900	0.136633E-02	0.136633E-02	0.136633E-02
0.950	0.140824E-02	0.140824E-02	0.140824E-02
1.000	0.143717E-02	0.143717E-02	0.143717E-02
1.050	0.146330E-02	0.146330E-02	0.146330E-02
1.100	0.148771E-02	0.148771E-02	0.148771E-02
1.150	0.151099E-02	0.151099E-02	0.151099E-02
1.200	0.153263E-02	0.153263E-02	0.153263E-02
1.250	0.155271E-02	0.155271E-02	0.155271E-02
1.300	0.157133E-02	0.157133E-02	0.157133E-02
1.350	0.158857E-02	0.158857E-02	0.158857E-02
1.400	0.160443E-02	0.160443E-02	0.160443E-02
1.450	0.161893E-02	0.161893E-02	0.161893E-02
1.500	0.163207E-02	0.163207E-02	0.163207E-02
1.550	0.164385E-02	0.164385E-02	0.164385E-02
1.600	0.165427E-02	0.165427E-02	0.165427E-02
1.650	0.166333E-02	0.166333E-02	0.166333E-02
1.700	0.167103E-02	0.167103E-02	0.167103E-02
1.750	0.167737E-02	0.167737E-02	0.167737E-02
1.800	0.168235E-02	0.168235E-02	0.168235E-02
1.850	0.168597E-02	0.168597E-02	0.168597E-02
1.900	0.168823E-02	0.168823E-02	0.168823E-02
1.950	0.168913E-02	0.168913E-02	0.168913E-02
2.000	0.168867E-02	0.168867E-02	0.168867E-02
2.050	0.168685E-02	0.168685E-02	0.168685E-02
2.100	0.168367E-02	0.168367E-02	0.168367E-02
2.150	0.167913E-02	0.167913E-02	0.167913E-02
2.200	0.167323E-02	0.167323E-02	0.167323E-02
2.250	0.166607E-02	0.166607E-02	0.166607E-02
2.300	0.165765E-02	0.165765E-02	0.165765E-02
2.350	0.164797E-02	0.164797E-02	0.164797E-02
2.400	0.163703E-02	0.163703E-02	0.163703E-02
2.450	0.162483E-02	0.162483E-02	0.162483E-02
2.500	0.161137E-02	0.161137E-02	0.161137E-02
2.550	0.159665E-02	0.159665E-02	0.159665E-02
2.600	0.158067E-02	0.158067E-02	0.158067E-02
2.650	0.156343E-02	0.156343E-02	0.156343E-02
2.700	0.154493E-02	0.154493E-02	0.154493E-02
2.750	0.152517E-02	0.152517E-02	0.152517E-02
2.800	0.150413E-02	0.150413E-02	0.150413E-02
2.850	0.148183E-02	0.148183E-02	0.148183E-02
2.900	0.145827E-02	0.145827E-02	0.145827E-02
2.950	0.143343E-02	0.143343E-02	0.143343E-02
3.000	0.140733E-02	0.140733E-02	0.140733E-02

Table 2.9

Kinetic energy of the incident proton is 15.0 GeV

Momentum of secondary negative kaon <GeV/c>	Zero Degree Production (sr.GeV/c) ⁻¹ Sanford-Wang's formula with kinematic reflection	Yamamoto's formula
0.30	0.9422282E-C3	0.930482E-C3
0.35	0.150120E-C2	0.148672E-C2
0.40	0.220549E-C2	0.219873E-C2
0.45	0.304266E-C2	0.306607E-C2
0.50	0.399468E-C2	0.405996E-C2
0.55	0.504149E-C2	0.517935E-C2
0.60	0.616340E-C2	0.639971E-C2
0.65	0.734264E-C2	0.770158E-C2
0.70	0.856388E-C2	0.906609E-C2
0.75	0.981438E-C2	0.104758E-C1
0.80	0.110840E-C1	0.119149E-C1
0.85	0.123649E-C1	0.133697E-C1
0.90	0.136509E-C1	0.148281E-C1
0.95	0.149373E-C1	0.162796E-C1
1.00	0.162221E-C1	0.177155E-C1
1.25	0.225415E-C1	0.244411E-C1
1.50	0.278714E-C1	0.300851E-C1
1.75	0.315639E-C1	0.344853E-C1
2.00	0.345422E-C1	0.376636E-C1
2.25	0.367738E-C1	0.397252E-C1
2.50	0.382608E-C1	0.408077E-C1
2.75	0.390335E-C1	0.410552E-C1
3.00	0.396143E-C1	0.406083E-C1
3.25	0.386580E-C1	0.395988E-C1
3.50	0.371655E-C1	0.381439E-C1
3.75	0.352180E-C1	0.363502E-C1
4.00	0.344321E-C1	0.343090E-C1
4.50	0.301423E-C1	0.297921E-C1
5.00	0.253869E-C1	0.250947E-C1
5.50	0.206449E-C1	0.205627E-C1
6.00	0.162529E-C1	0.164143E-C1
6.50	0.124118E-C1	0.127719E-C1
7.00	0.920832E-C2	0.968512E-C2
7.50	0.664446E-C2	0.715180E-C2
8.00	0.466710E-C2	0.513542E-C2
8.50	0.319269E-C2	0.357055E-C2
9.00	0.212821E-C2	0.241266E-C2
9.50	0.138224E-C2	0.156867E-C2
10.00	0.874589E-C3	0.975022E-C3

Table 2.10

π/k production ratios calculated using Sanford-Wang formula

Secondary particle momentum (GeV/c)	Proton Kinetic Energy			
	10 GeV		15 GeV	
	π^+/k^+	π^-/k^-	π^+/k^+	π^-/k^-
	-----	-----	-----	-----
0.30	106.1	434.3	100.6	320.7
0.35	90.1	324.3	92.4	263.0
0.40	73.5	235.5	85.4	221.8
0.45	61.8	180.4	72.1	170.2
0.50	53.1	144.1	62.5	136.3
0.55	46.5	119.0	54.8	112.9
0.60	41.3	101.0	48.9	96.1
0.65	37.0	87.5	44.2	83.7
0.70	33.6	77.2	40.3	74.1
0.75	30.7	69.0	37.0	66.6
0.80	28.2	62.5	34.3	60.7
0.85	26.0	57.1	31.9	55.8
0.90	24.1	52.6	29.8	51.7
0.95	22.5	48.8	28.0	48.3
1.00	21.0	45.5	26.4	45.3
1.25	17.3	36.4	20.4	35.3
1.50	16.5	33.4	17.7	30.2
1.75	15.7	31.5	17.2	27.6
2.00	14.9	30.4	16.6	25.3
2.25	14.2	29.9	16.1	24.5
2.50	13.4	29.9	15.6	23.5
2.75	12.7	30.3	15.1	22.9
3.00	12.0	31.1	14.6	22.5
3.25	11.3	32.3	14.1	22.2
3.50	10.7	33.8	13.6	22.2
3.75	10.1	35.8	13.1	22.3
4.00	9.6	38.3	12.6	22.6
4.50	8.7	44.8	11.7	23.5
5.00	8.0	54.1	10.8	24.6
5.50	7.6	67.0	10.1	27.0
6.00	7.5	85.2	9.4	29.7
6.50	7.8	111.0	8.9	33.2
7.00	8.7	147.9	8.4	37.6
7.50	10.5	201.5	8.1	43.2
8.00	14.0	280.2	8.0	50.3
8.50	21.0	397.6	8.0	59.3
9.00	36.0	575.2	8.2	70.6
9.50	72.9	848.0	8.7	85.1
10.00	177.9	1273.1	9.6	103.6

Table 2.11

Kinetic energy of the incident proton beam is 10.0 GeV

 Momentum Sanfird-Wang's Angular Dependence
 of with
 kinematic reflection

secondary antiproton	production angle in laboratory frame	0	1	2	4	8	16	24	32
<GeV/c>									
0.30	1.000	0.982	0.963	0.918	0.815	0.578	0.339	0.153	0.052
0.35	1.000	0.977	0.958	0.913	0.810	0.573	0.336	0.152	0.051
0.40	1.000	0.973	0.954	0.909	0.806	0.569	0.333	0.151	0.050
0.45	1.000	0.969	0.950	0.905	0.802	0.565	0.330	0.150	0.049
0.50	1.000	0.965	0.946	0.901	0.798	0.561	0.327	0.149	0.048
0.55	1.000	0.961	0.942	0.900	0.797	0.557	0.324	0.148	0.047
0.60	1.000	0.957	0.938	0.896	0.793	0.553	0.321	0.147	0.046
0.65	1.000	0.953	0.934	0.892	0.789	0.549	0.318	0.146	0.045
0.70	1.000	0.949	0.930	0.888	0.785	0.545	0.315	0.145	0.044
0.75	1.000	0.945	0.926	0.884	0.781	0.541	0.312	0.144	0.043
0.80	1.000	0.941	0.922	0.880	0.777	0.537	0.309	0.143	0.042
0.85	1.000	0.937	0.918	0.876	0.773	0.533	0.306	0.142	0.041
0.90	1.000	0.933	0.914	0.872	0.769	0.529	0.303	0.141	0.040
0.95	1.000	0.929	0.910	0.868	0.765	0.525	0.300	0.140	0.039
1.00	1.000	0.925	0.906	0.864	0.761	0.521	0.297	0.139	0.038
1.05	1.000	0.921	0.902	0.860	0.757	0.517	0.294	0.138	0.037
1.10	1.000	0.917	0.898	0.856	0.753	0.513	0.291	0.137	0.036
1.15	1.000	0.913	0.894	0.852	0.749	0.509	0.288	0.136	0.035
1.20	1.000	0.909	0.890	0.848	0.745	0.505	0.285	0.135	0.034
1.25	1.000	0.905	0.886	0.844	0.741	0.501	0.282	0.134	0.033
1.30	1.000	0.901	0.882	0.840	0.737	0.497	0.279	0.133	0.032
1.35	1.000	0.897	0.878	0.836	0.733	0.493	0.276	0.132	0.031
1.40	1.000	0.893	0.874	0.832	0.729	0.489	0.273	0.131	0.030
1.45	1.000	0.889	0.870	0.828	0.725	0.485	0.270	0.130	0.029
1.50	1.000	0.885	0.866	0.824	0.721	0.481	0.267	0.129	0.028
1.55	1.000	0.881	0.862	0.820	0.717	0.477	0.264	0.128	0.027
1.60	1.000	0.877	0.858	0.816	0.713	0.473	0.261	0.127	0.026
1.65	1.000	0.873	0.854	0.812	0.709	0.469	0.258	0.126	0.025
1.70	1.000	0.869	0.850	0.808	0.705	0.465	0.255	0.125	0.024
1.75	1.000	0.865	0.846	0.804	0.701	0.461	0.252	0.124	0.023
1.80	1.000	0.861	0.842	0.800	0.697	0.457	0.249	0.123	0.022
1.85	1.000	0.857	0.838	0.796	0.693	0.453	0.246	0.122	0.021
1.90	1.000	0.853	0.834	0.792	0.689	0.449	0.243	0.121	0.020
1.95	1.000	0.849	0.830	0.788	0.685	0.445	0.240	0.120	0.019
2.00	1.000	0.845	0.826	0.784	0.681	0.441	0.237	0.119	0.018
2.05	1.000	0.841	0.822	0.780	0.677	0.437	0.234	0.118	0.017
2.10	1.000	0.837	0.818	0.776	0.673	0.433	0.231	0.117	0.016
2.15	1.000	0.833	0.814	0.772	0.669	0.429	0.228	0.116	0.015
2.20	1.000	0.829	0.810	0.768	0.665	0.425	0.225	0.115	0.014
2.25	1.000	0.825	0.806	0.764	0.661	0.421	0.222	0.114	0.013
2.30	1.000	0.821	0.802	0.760	0.657	0.417	0.219	0.113	0.012
2.35	1.000	0.817	0.798	0.756	0.653	0.413	0.216	0.112	0.011
2.40	1.000	0.813	0.794	0.752	0.649	0.409	0.213	0.111	0.010
2.45	1.000	0.809	0.790	0.748	0.645	0.405	0.210	0.110	0.009
2.50	1.000	0.805	0.786	0.744	0.641	0.401	0.207	0.109	0.008
2.55	1.000	0.801	0.782	0.740	0.637	0.397	0.204	0.108	0.007
2.60	1.000	0.797	0.778	0.736	0.633	0.393	0.201	0.107	0.006
2.65	1.000	0.793	0.774	0.732	0.629	0.389	0.198	0.106	0.005
2.70	1.000	0.789	0.770	0.728	0.625	0.385	0.195	0.105	0.004
2.75	1.000	0.785	0.766	0.724	0.621	0.381	0.192	0.104	0.003
2.80	1.000	0.781	0.762	0.720	0.617	0.377	0.189	0.103	0.002
2.85	1.000	0.777	0.758	0.716	0.613	0.373	0.186	0.102	0.001
2.90	1.000	0.773	0.754	0.712	0.609	0.369	0.183	0.101	0.000
2.95	1.000	0.769	0.750	0.708	0.605	0.365	0.180	0.100	0.000
3.00	1.000	0.765	0.746	0.704	0.601	0.361	0.177	0.099	0.000
3.05	1.000	0.761	0.742	0.700	0.597	0.357	0.174	0.098	0.000
3.10	1.000	0.757	0.738	0.696	0.593	0.353	0.171	0.097	0.000
3.15	1.000	0.753	0.734	0.692	0.589	0.349	0.168	0.096	0.000
3.20	1.000	0.749	0.730	0.688	0.585	0.345	0.165	0.095	0.000
3.25	1.000	0.745	0.726	0.684	0.581	0.341	0.162	0.094	0.000
3.30	1.000	0.741	0.722	0.680	0.577	0.337	0.159	0.093	0.000
3.35	1.000	0.737	0.718	0.676	0.573	0.333	0.156	0.092	0.000
3.40	1.000	0.733	0.714	0.672	0.569	0.329	0.153	0.091	0.000
3.45	1.000	0.729	0.710	0.668	0.565	0.325	0.150	0.090	0.000
3.50	1.000	0.725	0.706	0.664	0.561	0.321	0.147	0.089	0.000
3.55	1.000	0.721	0.702	0.660	0.557	0.317	0.144	0.088	0.000
3.60	1.000	0.717	0.698	0.656	0.553	0.313	0.141	0.087	0.000
3.65	1.000	0.713	0.694	0.652	0.549	0.309	0.138	0.086	0.000
3.70	1.000	0.709	0.690	0.648	0.545	0.305	0.135	0.085	0.000
3.75	1.000	0.705	0.686	0.644	0.541	0.301	0.132	0.084	0.000
3.80	1.000	0.701	0.682	0.640	0.537	0.297	0.129	0.083	0.000
3.85	1.000	0.697	0.678	0.636	0.533	0.293	0.126	0.082	0.000
3.90	1.000	0.693	0.674	0.632	0.529	0.289	0.123	0.081	0.000
3.95	1.000	0.689	0.670	0.628	0.525	0.285	0.120	0.080	0.000
4.00	1.000	0.685	0.666	0.624	0.521	0.281	0.117	0.079	0.000
4.05	1.000	0.681	0.662	0.620	0.517	0.277	0.114	0.078	0.000
4.10	1.000	0.677	0.658	0.616	0.513	0.273	0.111	0.077	0.000
4.15	1.000	0.673	0.654	0.612	0.509	0.269	0.108	0.076	0.000
4.20	1.000	0.669	0.650	0.608	0.505	0.265	0.105	0.075	0.000
4.25	1.000	0.665	0.646	0.604	0.501	0.261	0.102	0.074	0.000
4.30	1.000	0.661	0.642	0.600	0.497	0.257	0.099	0.073	0.000
4.35	1.000	0.657	0.638	0.596	0.493	0.253	0.096	0.072	0.000
4.40	1.000	0.653	0.634	0.592	0.489	0.249	0.093	0.071	0.000
4.45	1.000	0.649	0.630	0.588	0.485	0.245	0.090	0.070	0.000
4.50	1.000	0.645	0.626	0.584	0.481	0.241	0.087	0.069	0.000
4.55	1.000	0.641	0.622	0.580	0.477	0.237	0.084	0.068	0.000
4.60	1.000	0.637	0.618	0.576	0.473	0.233	0.081	0.067	0.000
4.65	1.000	0.633	0.614	0.572	0.469	0.229	0.078	0.066	0.000
4.70	1.000	0.629	0.610	0.568	0.465	0.225	0.075	0.065	0.000
4.75	1.000	0.625	0.606	0.564	0.461	0.221	0.072	0.064	0.000
4.80	1.000	0.621	0.602	0.560	0.457	0.217	0.069	0.063	0.000
4.85	1.000	0.617	0.598	0.556	0.453	0.213	0.066	0.062	0.000
4.90	1.000	0.613	0.594	0.552	0.449	0.209	0.063	0.061	0.000
4.95	1.000	0.609	0.590	0.548	0.445	0.205	0.060	0.060	0.000
5.00	1.000	0.605	0.586	0.544	0.441	0.201	0.057	0.059	0.000
5.05	1.000	0.601	0.582	0.540	0.437	0.197	0.054	0.058	0.000
5.10	1.000	0.597	0.578	0.536	0.433	0.193	0.051	0.057	0.000
5.15	1.000	0.593	0.574	0.532	0.429	0.189	0.048	0.056	0.000
5.20	1.000	0.589	0.570	0.528	0.425	0.185	0.045	0.055	0.000
5.25	1.000	0.585	0.566	0.524	0.421	0.181	0.042	0.054	0.000
5.30	1.000	0.581	0.562	0.520	0.417	0.177	0.039	0.053	0.000
5.35	1.000	0.577	0.558	0.516	0.413	0.173	0.036	0.052	0.000
5.40	1.000	0.573	0.554	0.512	0.409	0.169	0.033	0.051	0.000
5.45	1.000	0.569	0.550	0.508	0.405	0.165	0.030	0.050	0.000
5.50	1.000	0.565	0.546	0.504	0.401	0.161	0.027	0.049	0.000
5.55	1.000	0.561	0.542	0.500	0.397	0.157	0.024	0.048	0.000
5.60	1.000	0.557	0.538	0.496	0.393	0.153	0.021	0.047	0.000
5.65	1.000	0.553	0.534	0.492	0.389	0.149	0.018	0.046	0.000
5.70	1.000	0.549	0.530	0.488	0.385	0.145	0.015	0.045	0.000
5.75	1.000	0.545	0.526	0.484	0.381	0.141	0.012	0.044	0.000
5.80	1.000	0.541	0.522	0.480	0.377	0.137	0.009	0.043	0.000
5.85	1.000	0.537	0.518	0.476	0.373	0.133	0.006	0.042	0.000
5.90	1.000	0.533	0.514	0.472	0.369	0.129	0.003	0.041	0.000
5.95	1.000	0.529	0.510	0.468	0.365	0.125	0.000	0.040	0.000
6.00	1.000	0.525	0.506	0.464	0.361	0.121	0.000	0.039	0.000
6.05	1.000	0.521	0.502	0.460	0.357				

kinetic energy of the incident proton beam is 15.0 GeV
 Momentum Sanford-Lang's Angular Dependence
 of with
 kinematic reflection

secondary

antiproton

production angle in laboratory frame

<GeV/c>	0	1	2	4	6	16	24	32
0.30	1.0000	0.9820	0.9620	0.9180	0.8110	0.5670	0.3420	0.1770
0.35	1.0000	0.9800	0.9520	0.9070	0.7890	0.5280	0.3290	0.1730
0.40	1.0000	0.9770	0.9480	0.8930	0.7690	0.4940	0.3240	0.1700
0.45	1.0000	0.9730	0.9440	0.8870	0.7510	0.4630	0.3200	0.1670
0.50	1.0000	0.9710	0.9400	0.8790	0.7340	0.4360	0.3170	0.1640
0.55	1.0000	0.9690	0.9360	0.8710	0.7190	0.4120	0.3120	0.1610
0.60	1.0000	0.9660	0.9330	0.8640	0.6920	0.3870	0.3070	0.1580
0.70	1.0000	0.9660	0.9330	0.8550	0.6810	0.3530	0.2880	0.1530
0.75	1.0000	0.9640	0.9320	0.8470	0.6610	0.3310	0.2830	0.1500
0.80	1.0000	0.9630	0.9320	0.8340	0.6450	0.3120	0.2750	0.1470
0.85	1.0000	0.9610	0.9320	0.8310	0.6330	0.2980	0.2680	0.1440
0.90	1.0000	0.9610	0.9320	0.8270	0.6240	0.2890	0.2610	0.1410
1.00	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
1.25	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
1.50	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
1.75	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
2.00	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
2.25	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
2.50	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
2.75	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
3.00	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
3.25	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
3.50	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
3.75	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
4.00	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
4.25	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
4.50	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
4.75	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
5.00	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
5.25	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
5.50	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
5.75	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
6.00	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
6.25	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
6.50	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
6.75	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
7.00	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
7.25	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
7.50	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
7.75	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
8.00	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
8.25	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
8.50	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
8.75	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
9.00	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
9.25	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
9.50	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380
10.00	1.0000	0.9610	0.9320	0.8240	0.6140	0.2790	0.2540	0.1380

Note : All angles are in degree

Table 3.2

Kinetic energy of the incident proton beam is 10.0 GeV

 Momentum Sanford-Wang's Angular Dependence
 of with
 kineatic reflection

secondary + pion		Production angle in laboratory frame										
<GeV/c>		0	1	2	4	6	16	24	32	40	48	56
0.30	0.00	1.000	1.121	1.243	1.437	1.440	0.859	0.533	0.433	0.333	0.233	0.133
0.35	1.000	1.000	1.141	1.263	1.513	1.407	0.727	0.466	0.366	0.266	0.166	0.066
0.40	1.000	1.000	1.136	1.257	1.463	1.358	0.644	0.388	0.288	0.188	0.088	0.033
0.45	1.000	1.000	1.131	1.244	1.453	1.312	0.588	0.333	0.233	0.133	0.033	0.000
0.50	1.000	1.000	1.126	1.233	1.443	1.263	0.544	0.288	0.188	0.088	0.033	0.000
0.55	1.000	1.000	1.121	1.221	1.433	1.180	0.476	0.233	0.133	0.033	0.000	0.000
0.60	1.000	1.000	1.116	1.211	1.423	1.140	0.444	0.233	0.133	0.033	0.000	0.000
0.65	1.000	1.000	1.111	1.201	1.413	1.100	0.414	0.233	0.133	0.033	0.000	0.000
0.70	1.000	1.000	1.107	1.191	1.403	1.062	0.386	0.233	0.133	0.033	0.000	0.000
0.75	1.000	1.000	1.102	1.181	1.393	1.020	0.360	0.233	0.133	0.033	0.000	0.000
0.80	1.000	1.000	1.097	1.171	1.383	0.978	0.335	0.233	0.133	0.033	0.000	0.000
0.85	1.000	1.000	1.092	1.161	1.373	0.936	0.312	0.233	0.133	0.033	0.000	0.000
0.90	1.000	1.000	1.087	1.151	1.363	0.893	0.291	0.233	0.133	0.033	0.000	0.000
0.95	1.000	1.000	1.082	1.141	1.353	0.851	0.272	0.233	0.133	0.033	0.000	0.000
1.00	1.000	1.000	1.077	1.131	1.343	0.809	0.251	0.233	0.133	0.033	0.000	0.000
1.05	1.000	1.000	1.072	1.121	1.333	0.767	0.231	0.233	0.133	0.033	0.000	0.000
1.10	1.000	1.000	1.067	1.111	1.323	0.725	0.210	0.233	0.133	0.033	0.000	0.000
1.15	1.000	1.000	1.062	1.101	1.313	0.683	0.190	0.233	0.133	0.033	0.000	0.000
1.20	1.000	1.000	1.057	1.091	1.303	0.641	0.169	0.233	0.133	0.033	0.000	0.000
1.25	1.000	1.000	1.052	1.081	1.293	0.599	0.148	0.233	0.133	0.033	0.000	0.000
1.30	1.000	1.000	1.047	1.071	1.283	0.557	0.128	0.233	0.133	0.033	0.000	0.000
1.35	1.000	1.000	1.042	1.061	1.273	0.515	0.107	0.233	0.133	0.033	0.000	0.000
1.40	1.000	1.000	1.037	1.051	1.263	0.473	0.087	0.233	0.133	0.033	0.000	0.000
1.45	1.000	1.000	1.032	1.041	1.253	0.431	0.066	0.233	0.133	0.033	0.000	0.000
1.50	1.000	1.000	1.027	1.031	1.243	0.389	0.046	0.233	0.133	0.033	0.000	0.000
1.55	1.000	1.000	1.022	1.021	1.233	0.347	0.025	0.233	0.133	0.033	0.000	0.000
1.60	1.000	1.000	1.017	1.011	1.223	0.305	0.005	0.233	0.133	0.033	0.000	0.000
1.65	1.000	1.000	1.012	1.001	1.213	0.263	0.000	0.233	0.133	0.033	0.000	0.000
1.70	1.000	1.000	1.007	0.991	1.203	0.221	0.000	0.233	0.133	0.033	0.000	0.000
1.75	1.000	1.000	1.002	0.981	1.193	0.179	0.000	0.233	0.133	0.033	0.000	0.000
1.80	1.000	1.000	1.000	0.976	1.183	0.137	0.000	0.233	0.133	0.033	0.000	0.000
1.85	1.000	1.000	1.000	0.971	1.173	0.095	0.000	0.233	0.133	0.033	0.000	0.000
1.90	1.000	1.000	1.000	0.966	1.163	0.053	0.000	0.233	0.133	0.033	0.000	0.000
1.95	1.000	1.000	1.000	0.961	1.153	0.011	0.000	0.233	0.133	0.033	0.000	0.000
2.00	1.000	1.000	1.000	0.956	1.143	0.000	0.000	0.233	0.133	0.033	0.000	0.000

Note : All angles are in degree

Table 3.3

kinetic energy of the incident proton beam is 10.0 GeV

Momentum Sanford-Wang's Angular Dependence
of kineematic reflection with

Secondary

- picn production angle in laboratory frame

$\langle \text{GeV}/c \rangle$	0	1	2	4	8	16	24	32
0.3	0000	1111	2222	4444	8888	1616	2424	3232
0.4	0000	1111	2222	4444	8888	1616	2424	3232
0.5	0000	1111	2222	4444	8888	1616	2424	3232
0.6	0000	1111	2222	4444	8888	1616	2424	3232
0.7	0000	1111	2222	4444	8888	1616	2424	3232
0.8	0000	1111	2222	4444	8888	1616	2424	3232
0.9	0000	1111	2222	4444	8888	1616	2424	3232
1.0	0000	1111	2222	4444	8888	1616	2424	3232
1.1	0000	1111	2222	4444	8888	1616	2424	3232
1.2	0000	1111	2222	4444	8888	1616	2424	3232
1.3	0000	1111	2222	4444	8888	1616	2424	3232
1.4	0000	1111	2222	4444	8888	1616	2424	3232
1.5	0000	1111	2222	4444	8888	1616	2424	3232
1.6	0000	1111	2222	4444	8888	1616	2424	3232
1.7	0000	1111	2222	4444	8888	1616	2424	3232
1.8	0000	1111	2222	4444	8888	1616	2424	3232
1.9	0000	1111	2222	4444	8888	1616	2424	3232
2.0	0000	1111	2222	4444	8888	1616	2424	3232
2.1	0000	1111	2222	4444	8888	1616	2424	3232
2.2	0000	1111	2222	4444	8888	1616	2424	3232
2.3	0000	1111	2222	4444	8888	1616	2424	3232
2.4	0000	1111	2222	4444	8888	1616	2424	3232
2.5	0000	1111	2222	4444	8888	1616	2424	3232
2.6	0000	1111	2222	4444	8888	1616	2424	3232
2.7	0000	1111	2222	4444	8888	1616	2424	3232
2.8	0000	1111	2222	4444	8888	1616	2424	3232
2.9	0000	1111	2222	4444	8888	1616	2424	3232
3.0	0000	1111	2222	4444	8888	1616	2424	3232
3.1	0000	1111	2222	4444	8888	1616	2424	3232
3.2	0000	1111	2222	4444	8888	1616	2424	3232
3.3	0000	1111	2222	4444	8888	1616	2424	3232
3.4	0000	1111	2222	4444	8888	1616	2424	3232
3.5	0000	1111	2222	4444	8888	1616	2424	3232
3.6	0000	1111	2222	4444	8888	1616	2424	3232
3.7	0000	1111	2222	4444	8888	1616	2424	3232
3.8	0000	1111	2222	4444	8888	1616	2424	3232
3.9	0000	1111	2222	4444	8888	1616	2424	3232
4.0	0000	1111	2222	4444	8888	1616	2424	3232
4.1	0000	1111	2222	4444	8888	1616	2424	3232
4.2	0000	1111	2222	4444	8888	1616	2424	3232
4.3	0000	1111	2222	4444	8888	1616	2424	3232
4.4	0000	1111	2222	4444	8888	1616	2424	3232
4.5	0000	1111	2222	4444	8888	1616	2424	3232
4.6	0000	1111	2222	4444	8888	1616	2424	3232
4.7	0000	1111	2222	4444	8888	1616	2424	3232
4.8	0000	1111	2222	4444	8888	1616	2424	3232
4.9	0000	1111	2222	4444	8888	1616	2424	3232
5.0	0000	1111	2222	4444	8888	1616	2424	3232
5.1	0000	1111	2222	4444	8888	1616	2424	3232
5.2	0000	1111	2222	4444	8888	1616	2424	3232
5.3	0000	1111	2222	4444	8888	1616	2424	3232
5.4	0000	1111	2222	4444	8888	1616	2424	3232
5.5	0000	1111	2222	4444	8888	1616	2424	3232
5.6	0000	1111	2222	4444	8888	1616	2424	3232
5.7	0000	1111	2222	4444	8888	1616	2424	3232
5.8	0000	1111	2222	4444	8888	1616	2424	3232
5.9	0000	1111	2222	4444	8888	1616	2424	3232
6.0	0000	1111	2222	4444	8888	1616	2424	3232
6.1	0000	1111	2222	4444	8888	1616	2424	3232
6.2	0000	1111	2222	4444	8888	1616	2424	3232
6.3	0000	1111	2222	4444	8888	1616	2424	3232
6.4	0000	1111	2222	4444	8888	1616	2424	3232
6.5	0000	1111	2222	4444	8888	1616	2424	3232
6.6	0000	1111	2222	4444	8888	1616	2424	3232
6.7	0000	1111	2222	4444	8888	1616	2424	3232
6.8	0000	1111	2222	4444	8888	1616	2424	3232
6.9	0000	1111	2222	4444	8888	1616	2424	3232
7.0	0000	1111	2222	4444	8888	1616	2424	3232
7.1	0000	1111	2222	4444	8888	1616	2424	3232
7.2	0000	1111	2222	4444	8888	1616	2424	3232
7.3	0000	1111	2222	4444	8888	1616	2424	3232
7.4	0000	1111	2222	4444	8888	1616	2424	3232
7.5	0000	1111	2222	4444	8888	1616	2424	3232
7.6	0000	1111	2222	4444	8888	1616	2424	3232
7.7	0000	1111	2222	4444	8888	1616	2424	3232
7.8	0000	1111	2222	4444	8888	1616	2424	3232
7.9	0000	1111	2222	4444	8888	1616	2424	3232
8.0	0000	1111	2222	4444	8888	1616	2424	3232
8.1	0000	1111	2222	4444	8888	1616	2424	3232
8.2	0000	1111	2222	4444	8888	1616	2424	3232
8.3	0000	1111	2222	4444	8888	1616	2424	3232
8.4	0000	1111	2222	4444	8888	1616	2424	3232
8.5	0000	1111	2222	4444	8888	1616	2424	3232
8.6	0000	1111	2222	4444	8888	1616	2424	3232
8.7	0000	1111	2222	4444	8888	1616	2424	3232
8.8	0000	1111	2222	4444	8888	1616	2424	3232
8.9	0000	1111	2222	4444	8888	1616	2424	3232
9.0	0000	1111	2222	4444	8888	1616	2424	3232
9.1	0000	1111	2222	4444	8888	1616	2424	3232
9.2	0000	1111	2222	4444	8888	1616	2424	3232
9.3	0000	1111	2222	4444	8888	1616	2424	3232
9.4	0000	1111	2222	4444	8888	1616	2424	3232
9.5	0000	1111	2222	4444	8888	1616	2424	3232
9.6	0000	1111	2222	4444	8888	1616	2424	3232
9.7	0000	1111	2222	4444	8888	1616	2424	3232
9.8	0000	1111	2222	4444	8888	1616	2424	3232
9.9	0000	1111	2222	4444	8888	1616	2424	3232
10.0	0000	1111	2222	4444	8888	1616	2424	3232

Note : All angles are in degree

Table 3.5

Kinetic energy of the incident proton beam is 15.0 GeV

 Momentum Sanford-Wang's Angular Dependence
 of with
 secondary kinematic reflection

- pich	Production angle in laboratory frame									
<GeV/c>	0	1	2	4	6	16	24	32	34	
0.30	1.0000	1.1344	1.2766	1.5511	1.8444	1.4236	0.7333	0.0000	0.0000	
0.35	1.0000	1.1891	1.3534	1.7600	1.9609	1.4611	0.7333	0.0000	0.0000	
0.40	1.0000	1.2511	1.5334	1.9537	1.8609	1.4611	0.7333	0.0000	0.0000	
0.45	1.0000	1.3246	1.6534	2.1937	1.7269	1.4611	0.7333	0.0000	0.0000	
0.50	1.0000	1.4000	1.7834	2.4837	1.5633	1.4611	0.7333	0.0000	0.0000	
0.55	1.0000	1.4734	1.9234	2.8237	1.3633	1.4611	0.7333	0.0000	0.0000	
0.60	1.0000	1.5434	2.0734	3.2137	1.1633	1.4611	0.7333	0.0000	0.0000	
0.65	1.0000	1.6134	2.2234	3.6537	0.9633	1.4611	0.7333	0.0000	0.0000	
0.70	1.0000	1.6834	2.3734	4.1437	0.7633	1.4611	0.7333	0.0000	0.0000	
0.75	1.0000	1.7534	2.5234	4.6837	0.5633	1.4611	0.7333	0.0000	0.0000	
0.80	1.0000	1.8234	2.6734	5.2737	0.3633	1.4611	0.7333	0.0000	0.0000	
0.85	1.0000	1.8934	2.8234	5.9137	0.1633	1.4611	0.7333	0.0000	0.0000	
0.90	1.0000	1.9634	2.9734	6.6037	0.0000	1.4611	0.7333	0.0000	0.0000	
0.95	1.0000	2.0334	3.1234	7.3437	0.0000	1.4611	0.7333	0.0000	0.0000	
1.00	1.0000	2.1034	3.2734	8.1337	0.0000	1.4611	0.7333	0.0000	0.0000	
1.05	1.0000	2.1734	3.4234	8.9737	0.0000	1.4611	0.7333	0.0000	0.0000	
1.10	1.0000	2.2434	3.5734	9.8637	0.0000	1.4611	0.7333	0.0000	0.0000	
1.15	1.0000	2.3134	3.7234	10.8037	0.0000	1.4611	0.7333	0.0000	0.0000	
1.20	1.0000	2.3834	3.8734	11.7937	0.0000	1.4611	0.7333	0.0000	0.0000	
1.25	1.0000	2.4534	4.0234	12.8337	0.0000	1.4611	0.7333	0.0000	0.0000	
1.30	1.0000	2.5234	4.1734	13.9237	0.0000	1.4611	0.7333	0.0000	0.0000	
1.35	1.0000	2.5934	4.3234	15.0637	0.0000	1.4611	0.7333	0.0000	0.0000	
1.40	1.0000	2.6634	4.4734	16.2537	0.0000	1.4611	0.7333	0.0000	0.0000	
1.45	1.0000	2.7334	4.6234	17.4937	0.0000	1.4611	0.7333	0.0000	0.0000	
1.50	1.0000	2.8034	4.7734	18.7837	0.0000	1.4611	0.7333	0.0000	0.0000	
1.55	1.0000	2.8734	4.9234	20.1237	0.0000	1.4611	0.7333	0.0000	0.0000	
1.60	1.0000	2.9434	5.0734	21.5137	0.0000	1.4611	0.7333	0.0000	0.0000	
1.65	1.0000	3.0134	5.2234	22.9537	0.0000	1.4611	0.7333	0.0000	0.0000	
1.70	1.0000	3.0834	5.3734	24.4437	0.0000	1.4611	0.7333	0.0000	0.0000	
1.75	1.0000	3.1534	5.5234	25.9837	0.0000	1.4611	0.7333	0.0000	0.0000	
1.80	1.0000	3.2234	5.6734	27.5737	0.0000	1.4611	0.7333	0.0000	0.0000	
1.85	1.0000	3.2934	5.8234	29.2137	0.0000	1.4611	0.7333	0.0000	0.0000	
1.90	1.0000	3.3634	5.9734	30.9037	0.0000	1.4611	0.7333	0.0000	0.0000	
1.95	1.0000	3.4334	6.1234	32.6437	0.0000	1.4611	0.7333	0.0000	0.0000	
2.00	1.0000	3.5034	6.2734	34.4337	0.0000	1.4611	0.7333	0.0000	0.0000	
2.05	1.0000	3.5734	6.4234	36.2737	0.0000	1.4611	0.7333	0.0000	0.0000	
2.10	1.0000	3.6434	6.5734	38.1637	0.0000	1.4611	0.7333	0.0000	0.0000	
2.15	1.0000	3.7134	6.7234	40.1037	0.0000	1.4611	0.7333	0.0000	0.0000	
2.20	1.0000	3.7834	6.8734	42.0937	0.0000	1.4611	0.7333	0.0000	0.0000	
2.25	1.0000	3.8534	7.0234	44.1337	0.0000	1.4611	0.7333	0.0000	0.0000	
2.30	1.0000	3.9234	7.1734	46.2237	0.0000	1.4611	0.7333	0.0000	0.0000	
2.35	1.0000	3.9934	7.3234	48.3637	0.0000	1.4611	0.7333	0.0000	0.0000	
2.40	1.0000	4.0634	7.4734	50.5537	0.0000	1.4611	0.7333	0.0000	0.0000	
2.45	1.0000	4.1334	7.6234	52.7937	0.0000	1.4611	0.7333	0.0000	0.0000	
2.50	1.0000	4.2034	7.7734	55.0837	0.0000	1.4611	0.7333	0.0000	0.0000	
2.55	1.0000	4.2734	7.9234	57.4237	0.0000	1.4611	0.7333	0.0000	0.0000	
2.60	1.0000	4.3434	8.0734	59.8137	0.0000	1.4611	0.7333	0.0000	0.0000	
2.65	1.0000	4.4134	8.2234	62.2537	0.0000	1.4611	0.7333	0.0000	0.0000	
2.70	1.0000	4.4834	8.3734	64.7437	0.0000	1.4611	0.7333	0.0000	0.0000	
2.75	1.0000	4.5534	8.5234	67.2837	0.0000	1.4611	0.7333	0.0000	0.0000	
2.80	1.0000	4.6234	8.6734	69.8737	0.0000	1.4611	0.7333	0.0000	0.0000	
2.85	1.0000	4.6934	8.8234	72.5137	0.0000	1.4611	0.7333	0.0000	0.0000	
2.90	1.0000	4.7634	8.9734	75.2037	0.0000	1.4611	0.7333	0.0000	0.0000	
2.95	1.0000	4.8334	9.1234	77.9437	0.0000	1.4611	0.7333	0.0000	0.0000	
3.00	1.0000	4.9034	9.2734	80.7337	0.0000	1.4611	0.7333	0.0000	0.0000	
3.05	1.0000	4.9734	9.4234	83.5737	0.0000	1.4611	0.7333	0.0000	0.0000	
3.10	1.0000	5.0434	9.5734	86.4637	0.0000	1.4611	0.7333	0.0000	0.0000	
3.15	1.0000	5.1134	9.7234	89.4037	0.0000	1.4611	0.7333	0.0000	0.0000	
3.20	1.0000	5.1834	9.8734	92.3937	0.0000	1.4611	0.7333	0.0000	0.0000	
3.25	1.0000	5.2534	10.0234	95.4337	0.0000	1.4611	0.7333	0.0000	0.0000	
3.30	1.0000	5.3234	10.1734	98.5237	0.0000	1.4611	0.7333	0.0000	0.0000	
3.35	1.0000	5.3934	10.3234	101.6637	0.0000	1.4611	0.7333	0.0000	0.0000	
3.40	1.0000	5.4634	10.4734	104.8537	0.0000	1.4611	0.7333	0.0000	0.0000	
3.45	1.0000	5.5334	10.6234	108.0937	0.0000	1.4611	0.7333	0.0000	0.0000	
3.50	1.0000	5.6034	10.7734	111.3837	0.0000	1.4611	0.7333	0.0000	0.0000	
3.55	1.0000	5.6734	10.9234	114.7237	0.0000	1.4611	0.7333	0.0000	0.0000	
3.60	1.0000	5.7434	11.0734	118.1137	0.0000	1.4611	0.7333	0.0000	0.0000	
3.65	1.0000	5.8134	11.2234	121.5537	0.0000	1.4611	0.7333	0.0000	0.0000	
3.70	1.0000	5.8834	11.3734	125.0437	0.0000	1.4611	0.7333	0.0000	0.0000	
3.75	1.0000	5.9534	11.5234	128.5837	0.0000	1.4611	0.7333	0.0000	0.0000	
3.80	1.0000	6.0234	11.6734	132.1737	0.0000	1.4611	0.7333	0.0000	0.0000	
3.85	1.0000	6.0934	11.8234	135.8137	0.0000	1.4611	0.7333	0.0000	0.0000	
3.90	1.0000	6.1634	11.9734	139.5037	0.0000	1.4611	0.7333	0.0000	0.0000	
3.95	1.0000	6.2334	12.1234	143.2437	0.0000	1.4611	0.7333	0.0000	0.0000	
4.00	1.0000	6.3034	12.2734	147.0337	0.0000	1.4611	0.7333	0.0000	0.0000	
4.05	1.0000	6.3734	12.4234	150.8737	0.0000	1.4611	0.7333	0.0000	0.0000	
4.10	1.0000	6.4434	12.5734	154.7637	0.0000	1.4611	0.7333	0.0000	0.0000	
4.15	1.0000	6.5134	12.7234	158.7037	0.0000	1.4611	0.7333	0.0000	0.0000	
4.20	1.0000	6.5834	12.8734	162.6937	0.0000	1.4611	0.7333	0.0000	0.0000	
4.25	1.0000	6.6534	13.0234	166.7337	0.0000	1.4611	0.7333	0.0000	0.0000	
4.30	1.0000	6.7234	13.1734	170.8237	0.0000	1.4611	0.7333	0.0000	0.0000	
4.35	1.0000	6.7934	13.3234	174.9637	0.0000	1.4611	0.7333	0.0000	0.0000	
4.40	1.0000	6.8634	13.4734	179.1537	0.0000	1.4611	0.7333	0.0000	0.0000	
4.45	1.0000	6.9334	13.6234	183.3937	0.0000	1.4611	0.7333	0.0000	0.0000	
4.50	1.0000	7.0034	13.7734	187.6837	0.0000	1.4611	0.7333	0.0000	0.0000	
4.55	1.0000	7.0734	13.9234	192.0237	0.0000	1.4611	0.7333	0.0000	0.0000	
4.60	1.0000	7.1434	14.0734	196.4137	0.0000	1.4611	0.7333	0.0000	0.0000	
4.65	1.0000	7.2134	14.2234	200.8537	0.0000	1.4611	0.7333	0.0000	0.0000	
4.70	1.0000	7.2834	14.3734	205.3437	0.0000	1.4611	0.7333	0.0000	0.0000	
4.75	1.0000	7.3534	14.5234	209.8837	0.0000	1.4611	0.7333	0.0000	0.0000	
4.80	1.0000	7.4234	14.6734	214.4737	0.0000	1.4611	0.7333	0.0000	0.0000	
4.85	1.0000	7.4934	14.8234	219.1137	0.0000	1.4611	0.7333	0.0000	0.0000	
4.90	1.0000	7.5634	14.9734	223.8037	0.0000	1.4611	0.7333	0.0000	0.0000	
4.95	1.0000	7.6334	15.1234	228.5437	0.0000	1.4611	0.7333	0.0000	0.0000	
5.00	1.0000	7.7034	15.2734	233.3337	0.0000	1.4611	0.7333	0.0000	0.0000	
5.05	1.0000	7.7734	15.4234	238.1737	0.0000	1.4611	0.7333	0.0000	0.0000	
5.10	1.0000	7.8434	15.5734	243.0637	0.0000	1.4611	0.7333	0.0000	0.0000	
5.15	1.0000	7.9134	15.7234	248.0037	0.0000	1.4611	0.7333	0.0000	0.0000	
5.20	1.0000	7.9834	15.8734	253.0037	0.0000	1.4611	0.7333	0.0000	0.0000	
5.25	1.0000	8.0534	16.0234	258.0537	0.0000	1.4611	0.7333	0.0000	0.0000	
5.30	1.0000	8.1234	16.1734	263.1537	0.0000	1.4611	0.7333	0.0000	0.0000	
5.35	1.0000	8.1934	16.3234	268.3037	0.0000	1.4611	0.7333	0.0000	0.0000	
5.40	1.0000	8.2634	16.4734	273.5037	0.0000	1.4611	0.7333	0.0000	0.0000	
5.45	1.0000	8.3334	16.6234	278.7537	0.0000	1.4611	0.7333	0.0000	0.0000	
5.50	1.0000	8.4034	16.7734	284.0537	0.0000	1.4611	0.7333	0.0000	0.0000	
5.55	1.0000	8.4								

kinetic energy of the incident proton beam is 10.0 GeV
 Momentum Sanford-Rang's Angular Dependence
 of with kinetic reflection

secondary

- kaon production angle in laboratory frame

<GeV/c>	0	1	2	4	6	16	24	32
0.30	1.000	0.589	0.578	0.952	0.894	0.745	0.552	0.424
0.35	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
0.40	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
0.45	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
0.50	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
0.55	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
0.60	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
0.65	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
0.70	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
0.75	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
0.80	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
0.85	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
0.90	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
0.95	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
1.00	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
1.05	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
1.10	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
1.15	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
1.20	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
1.25	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
1.30	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
1.35	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
1.40	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
1.45	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
1.50	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
1.55	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
1.60	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
1.65	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
1.70	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
1.75	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
1.80	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
1.85	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
1.90	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
1.95	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423
2.00	1.000	0.589	0.577	0.950	0.888	0.731	0.550	0.423

Note : All angles are in degree

Table 3.9

Kinetic energy of the incident proton beam is 15.0 GeV
 Momentum Sanford-Wang's Angular Dependence
 of with
 kineatic reflection

Secondary		Production angle in laboratory frame									
- kaon											
<GeV/c>	0	1	2	4	6	16	24	32			
0.330	1.000	0.989	0.978	0.950	0.893	0.733	0.530	0.387			
0.350	1.000	0.989	0.977	0.950	0.888	0.733	0.530	0.387			
0.400	1.000	0.991	0.979	0.952	0.891	0.741	0.540	0.391			
0.450	1.000	0.992	0.980	0.953	0.892	0.741	0.540	0.391			
0.500	1.000	0.994	0.982	0.955	0.893	0.741	0.540	0.391			
0.550	1.000	0.997	0.984	0.957	0.895	0.741	0.540	0.391			
0.600	1.000	0.999	0.986	0.959	0.897	0.741	0.540	0.391			
0.650	1.000	1.000	0.987	0.960	0.898	0.741	0.540	0.391			
0.700	1.000	1.000	0.989	0.962	0.900	0.741	0.540	0.391			
0.750	1.000	1.000	0.991	0.964	0.901	0.741	0.540	0.391			
0.800	1.000	1.000	0.992	0.965	0.902	0.741	0.540	0.391			
0.850	1.000	1.000	0.993	0.966	0.903	0.741	0.540	0.391			
0.900	1.000	1.000	0.994	0.967	0.904	0.741	0.540	0.391			
0.950	1.000	1.000	0.995	0.968	0.905	0.741	0.540	0.391			
1.000	1.000	1.000	0.996	0.969	0.906	0.741	0.540	0.391			
1.050	1.000	1.000	0.997	0.970	0.907	0.741	0.540	0.391			
1.100	1.000	1.000	0.998	0.971	0.908	0.741	0.540	0.391			
1.150	1.000	1.000	0.999	0.972	0.909	0.741	0.540	0.391			
1.200	1.000	1.000	1.000	0.973	0.910	0.741	0.540	0.391			
1.250	1.000	1.000	1.000	0.974	0.911	0.741	0.540	0.391			
1.300	1.000	1.000	1.000	0.975	0.912	0.741	0.540	0.391			
1.350	1.000	1.000	1.000	0.976	0.913	0.741	0.540	0.391			
1.400	1.000	1.000	1.000	0.977	0.914	0.741	0.540	0.391			
1.450	1.000	1.000	1.000	0.978	0.915	0.741	0.540	0.391			
1.500	1.000	1.000	1.000	0.979	0.916	0.741	0.540	0.391			
1.550	1.000	1.000	1.000	0.980	0.917	0.741	0.540	0.391			
1.600	1.000	1.000	1.000	0.981	0.918	0.741	0.540	0.391			
1.650	1.000	1.000	1.000	0.982	0.919	0.741	0.540	0.391			
1.700	1.000	1.000	1.000	0.983	0.920	0.741	0.540	0.391			
1.750	1.000	1.000	1.000	0.984	0.921	0.741	0.540	0.391			
1.800	1.000	1.000	1.000	0.985	0.922	0.741	0.540	0.391			
1.850	1.000	1.000	1.000	0.986	0.923	0.741	0.540	0.391			
1.900	1.000	1.000	1.000	0.987	0.924	0.741	0.540	0.391			
1.950	1.000	1.000	1.000	0.988	0.925	0.741	0.540	0.391			
2.000	1.000	1.000	1.000	0.989	0.926	0.741	0.540	0.391			
2.050	1.000	1.000	1.000	0.990	0.927	0.741	0.540	0.391			
2.100	1.000	1.000	1.000	0.991	0.928	0.741	0.540	0.391			
2.150	1.000	1.000	1.000	0.992	0.929	0.741	0.540	0.391			
2.200	1.000	1.000	1.000	0.993	0.930	0.741	0.540	0.391			
2.250	1.000	1.000	1.000	0.994	0.931	0.741	0.540	0.391			
2.300	1.000	1.000	1.000	0.995	0.932	0.741	0.540	0.391			
2.350	1.000	1.000	1.000	0.996	0.933	0.741	0.540	0.391			
2.400	1.000	1.000	1.000	0.997	0.934	0.741	0.540	0.391			
2.450	1.000	1.000	1.000	0.998	0.935	0.741	0.540	0.391			
2.500	1.000	1.000	1.000	0.999	0.936	0.741	0.540	0.391			
2.550	1.000	1.000	1.000	1.000	0.937	0.741	0.540	0.391			
2.600	1.000	1.000	1.000	1.000	0.938	0.741	0.540	0.391			
2.650	1.000	1.000	1.000	1.000	0.939	0.741	0.540	0.391			
2.700	1.000	1.000	1.000	1.000	0.940	0.741	0.540	0.391			
2.750	1.000	1.000	1.000	1.000	0.941	0.741	0.540	0.391			
2.800	1.000	1.000	1.000	1.000	0.942	0.741	0.540	0.391			
2.850	1.000	1.000	1.000	1.000	0.943	0.741	0.540	0.391			
2.900	1.000	1.000	1.000	1.000	0.944	0.741	0.540	0.391			
2.950	1.000	1.000	1.000	1.000	0.945	0.741	0.540	0.391			
3.000	1.000	1.000	1.000	1.000	0.946	0.741	0.540	0.391			
3.050	1.000	1.000	1.000	1.000	0.947	0.741	0.540	0.391			
3.100	1.000	1.000	1.000	1.000	0.948	0.741	0.540	0.391			
3.150	1.000	1.000	1.000	1.000	0.949	0.741	0.540	0.391			
3.200	1.000	1.000	1.000	1.000	0.950	0.741	0.540	0.391			
3.250	1.000	1.000	1.000	1.000	0.951	0.741	0.540	0.391			
3.300	1.000	1.000	1.000	1.000	0.952	0.741	0.540	0.391			
3.350	1.000	1.000	1.000	1.000	0.953	0.741	0.540	0.391			
3.400	1.000	1.000	1.000	1.000	0.954	0.741	0.540	0.391			
3.450	1.000	1.000	1.000	1.000	0.955	0.741	0.540	0.391			
3.500	1.000	1.000	1.000	1.000	0.956	0.741	0.540	0.391			
3.550	1.000	1.000	1.000	1.000	0.957	0.741	0.540	0.391			
3.600	1.000	1.000	1.000	1.000	0.958	0.741	0.540	0.391			
3.650	1.000	1.000	1.000	1.000	0.959	0.741	0.540	0.391			
3.700	1.000	1.000	1.000	1.000	0.960	0.741	0.540	0.391			
3.750	1.000	1.000	1.000	1.000	0.961	0.741	0.540	0.391			
3.800	1.000	1.000	1.000	1.000	0.962	0.741	0.540	0.391			
3.850	1.000	1.000	1.000	1.000	0.963	0.741	0.540	0.391			
3.900	1.000	1.000	1.000	1.000	0.964	0.741	0.540	0.391			
3.950	1.000	1.000	1.000	1.000	0.965	0.741	0.540	0.391			
4.000	1.000	1.000	1.000	1.000	0.966	0.741	0.540	0.391			
4.050	1.000	1.000	1.000	1.000	0.967	0.741	0.540	0.391			
4.100	1.000	1.000	1.000	1.000	0.968	0.741	0.540	0.391			
4.150	1.000	1.000	1.000	1.000	0.969	0.741	0.540	0.391			
4.200	1.000	1.000	1.000	1.000	0.970	0.741	0.540	0.391			
4.250	1.000	1.000	1.000	1.000	0.971	0.741	0.540	0.391			
4.300	1.000	1.000	1.000	1.000	0.972	0.741	0.540	0.391			
4.350	1.000	1.000	1.000	1.000	0.973	0.741	0.540	0.391			
4.400	1.000	1.000	1.000	1.000	0.974	0.741	0.540	0.391			
4.450	1.000	1.000	1.000	1.000	0.975	0.741	0.540	0.391			
4.500	1.000	1.000	1.000	1.000	0.976	0.741	0.540	0.391			
4.550	1.000	1.000	1.000	1.000	0.977	0.741	0.540	0.391			
4.600	1.000	1.000	1.000	1.000	0.978	0.741	0.540	0.391			
4.650	1.000	1.000	1.000	1.000	0.979	0.741	0.540	0.391			
4.700	1.000	1.000	1.000	1.000	0.980	0.741	0.540	0.391			
4.750	1.000	1.000	1.000	1.000	0.981	0.741	0.540	0.391			
4.800	1.000	1.000	1.000	1.000	0.982	0.741	0.540	0.391			
4.850	1.000	1.000	1.000	1.000	0.983	0.741	0.540	0.391			
4.900	1.000	1.000	1.000	1.000	0.984	0.741	0.540	0.391			
4.950	1.000	1.000	1.000	1.000	0.985	0.741	0.540	0.391			
5.000	1.000	1.000	1.000	1.000	0.986	0.741	0.540	0.391			

Decay of neutral kaon to positive and negative pion

Neutral Kaon		Decay angle in centre of momentum frame					
		0.0		90.0		179.9999	
		in laboratory frame					
P of kaon	T of kaon	P of pion	decay angle	P of pion	decay angle	P of pion	decay angle
0.30	0.083	0.391	0.0	0.255	53.941	0.0905	179.9998
0.35	0.111	0.427	0.0	0.270	49.653	0.0769	179.9997
0.40	0.141	0.464	0.0	0.287	45.848	0.0643	179.9997
0.45	0.173	0.503	0.0	0.305	42.477	0.0527	179.9996
0.50	0.208	0.542	0.0	0.324	39.490	0.0420	179.9995
0.55	0.244	0.582	0.0	0.344	36.838	0.0320	179.9994
0.60	0.282	0.623	0.0	0.364	34.477	0.0227	179.9992
0.65	0.321	0.664	0.0	0.385	32.370	0.0139	179.9986
0.70	0.361	0.706	0.0	0.406	30.481	0.0055	179.9966
0.75	0.402	0.748	0.0	0.428	28.783	0.0024	0.0078
0.80	0.444	0.790	0.0	0.450	27.250	0.0100	0.0019
0.85	0.487	0.833	0.0	0.472	25.861	0.0173	0.0011
0.90	0.531	0.876	0.0	0.495	24.598	0.0243	0.0008
0.95	0.575	0.919	0.0	0.518	23.447	0.0311	0.0006
1.00	0.619	0.962	0.0	0.541	22.393	0.0376	0.0005
1.25	0.848	1.182	0.0	0.658	18.243	0.0681	0.0003
1.50	1.083	1.404	0.0	0.778	15.359	0.0958	0.0002
1.75	1.322	1.628	0.0	0.899	13.248	0.1219	0.0002
2.00	1.563	1.853	0.0	1.021	11.641	0.1469	0.0001
2.25	1.807	2.079	0.0	1.144	10.377	0.1711	0.0001
2.50	2.051	2.305	0.0	1.267	9.359	0.1948	0.0001
2.75	2.297	2.532	0.0	1.390	8.521	0.2181	0.0001
3.00	2.543	2.759	0.0	1.514	7.820	0.2412	0.0001
3.25	2.790	2.986	0.0	1.638	7.225	0.2640	0.0001
3.50	3.038	3.213	0.0	1.762	6.714	0.2866	0.0001
3.75	3.285	3.441	0.0	1.886	6.270	0.3091	0.0001
4.00	3.533	3.669	0.0	2.011	5.881	0.3314	0.0001
4.50	4.030	4.124	0.0	2.259	5.231	0.3759	0.0000
5.00	4.527	4.580	0.0	2.508	4.711	0.4200	0.0000
5.50	5.025	5.036	0.0	2.758	4.284	0.4640	0.0000
6.00	5.523	5.492	0.0	3.007	3.928	0.5078	0.0000
6.50	6.021	5.949	0.0	3.257	3.627	0.5515	0.0000
7.00	6.520	6.405	0.0	3.506	3.369	0.5950	0.0000
7.50	7.019	6.861	0.0	3.756	3.144	0.6386	0.0000
8.00	7.518	7.318	0.0	4.005	2.948	0.6820	0.0000
8.50	8.017	7.775	0.0	4.255	2.775	0.7254	0.0000
9.00	8.516	8.231	0.0	4.505	2.621	0.7688	0.0000
9.50	9.015	8.688	0.0	4.754	2.483	0.8121	0.0000
10.00	9.515	9.145	0.0	5.004	2.359	0.8554	0.0000
10.50	10.014	9.601	0.0	5.254	2.247	0.8987	0.0000
11.00	10.514	10.058	0.0	5.504	2.145	0.9419	0.0000
11.50	11.013	10.515	0.0	5.754	2.052	0.9851	0.0000
12.00	11.513	10.972	0.0	6.004	1.966	1.0283	0.0000
12.50	12.012	11.428	0.0	6.253	1.888	1.0715	0.0000
13.00	12.512	11.885	0.0	6.503	1.815	1.1147	0.0000
13.50	13.011	12.342	0.0	6.753	1.748	1.1579	0.0000
14.00	13.511	12.799	0.0	7.003	1.686	1.2011	0.0000
14.50	14.011	13.256	0.0	7.253	1.628	1.2442	0.0000
15.00	14.511	13.713	0.0	7.503	1.573	1.2873	0.0000

- Notes (1) P = momentum <GeV/c>, T = kinetic energy <GeV>
(2) All angles are in degree
(3) Momentum and decay angle of positive pion is printed

Table 4.1

Decay of charged kaon to charged pion and neutral pion

Kaon

Decay angle in centre of momentum frame
0.0 90.0 179.9999

in laboratory frame

P of kaon	T of kaon	P of pion	decay angle	P of pion	decay angle	P of pion	decay angle
0.35	0.084	0.427	0.0	0.270	53.684	0.0	179.9998
0.40	0.111	0.445	0.0	0.277	49.387	0.0	179.9997
0.45	0.142	0.504	0.0	0.305	45.579	0.0	179.9997
0.50	0.174	0.543	0.0	0.324	42.269	0.0	179.9996
0.55	0.209	0.584	0.0	0.344	39.580	0.0	179.9995
0.60	0.245	0.624	0.0	0.365	36.226	0.0	179.9991
0.65	0.283	0.668	0.0	0.386	32.246	0.0	179.9985
0.70	0.323	0.710	0.0	0.407	28.556	0.0	179.9984
0.75	0.363	0.750	0.0	0.429	25.631	0.0	179.9984
0.80	0.404	0.793	0.0	0.451	22.395	0.0	179.9984
0.85	0.446	0.836	0.0	0.474	19.650	0.0	179.9984
0.90	0.489	0.879	0.0	0.497	17.395	0.0	179.9984
0.95	0.537	0.922	0.0	0.520	15.623	0.0	179.9984
1.00	0.577	0.967	0.0	0.543	13.883	0.0	179.9984
1.05	0.620	1.010	0.0	0.566	12.223	0.0	179.9984
1.10	0.665	1.055	0.0	0.589	10.635	0.0	179.9984
1.15	0.710	1.100	0.0	0.612	9.112	0.0	179.9984
1.20	0.755	1.145	0.0	0.635	7.644	0.0	179.9984
1.25	0.800	1.190	0.0	0.658	6.232	0.0	179.9984
1.30	0.845	1.235	0.0	0.681	4.875	0.0	179.9984
1.35	0.890	1.280	0.0	0.704	3.572	0.0	179.9984
1.40	0.935	1.325	0.0	0.727	2.322	0.0	179.9984
1.45	0.980	1.370	0.0	0.750	1.125	0.0	179.9984
1.50	1.025	1.415	0.0	0.773	0.977	0.0	179.9984
1.55	1.070	1.460	0.0	0.796	0.830	0.0	179.9984
1.60	1.115	1.505	0.0	0.819	0.683	0.0	179.9984
1.65	1.160	1.550	0.0	0.842	0.536	0.0	179.9984
1.70	1.205	1.595	0.0	0.865	0.389	0.0	179.9984
1.75	1.250	1.640	0.0	0.888	0.242	0.0	179.9984
1.80	1.295	1.685	0.0	0.911	0.095	0.0	179.9984
1.85	1.340	1.730	0.0	0.934	0.0	0.0	179.9984
1.90	1.385	1.775	0.0	0.957	0.0	0.0	179.9984
1.95	1.430	1.820	0.0	0.980	0.0	0.0	179.9984
2.00	1.475	1.865	0.0	1.003	0.0	0.0	179.9984
2.05	1.520	1.910	0.0	1.026	0.0	0.0	179.9984
2.10	1.565	1.955	0.0	1.049	0.0	0.0	179.9984
2.15	1.610	2.000	0.0	1.072	0.0	0.0	179.9984
2.20	1.655	2.045	0.0	1.095	0.0	0.0	179.9984
2.25	1.700	2.090	0.0	1.118	0.0	0.0	179.9984
2.30	1.745	2.135	0.0	1.141	0.0	0.0	179.9984
2.35	1.790	2.180	0.0	1.164	0.0	0.0	179.9984
2.40	1.835	2.225	0.0	1.187	0.0	0.0	179.9984
2.45	1.880	2.270	0.0	1.210	0.0	0.0	179.9984
2.50	1.925	2.315	0.0	1.233	0.0	0.0	179.9984
2.55	1.970	2.360	0.0	1.256	0.0	0.0	179.9984
2.60	2.015	2.405	0.0	1.279	0.0	0.0	179.9984
2.65	2.060	2.450	0.0	1.302	0.0	0.0	179.9984
2.70	2.105	2.495	0.0	1.325	0.0	0.0	179.9984
2.75	2.150	2.540	0.0	1.348	0.0	0.0	179.9984
2.80	2.195	2.585	0.0	1.371	0.0	0.0	179.9984
2.85	2.240	2.630	0.0	1.394	0.0	0.0	179.9984
2.90	2.285	2.675	0.0	1.417	0.0	0.0	179.9984
2.95	2.330	2.720	0.0	1.440	0.0	0.0	179.9984
3.00	2.375	2.765	0.0	1.463	0.0	0.0	179.9984
3.05	2.420	2.810	0.0	1.486	0.0	0.0	179.9984
3.10	2.465	2.855	0.0	1.509	0.0	0.0	179.9984
3.15	2.510	2.900	0.0	1.532	0.0	0.0	179.9984
3.20	2.555	2.945	0.0	1.555	0.0	0.0	179.9984
3.25	2.600	2.990	0.0	1.578	0.0	0.0	179.9984
3.30	2.645	3.035	0.0	1.601	0.0	0.0	179.9984
3.35	2.690	3.080	0.0	1.624	0.0	0.0	179.9984
3.40	2.735	3.125	0.0	1.647	0.0	0.0	179.9984
3.45	2.780	3.170	0.0	1.670	0.0	0.0	179.9984
3.50	2.825	3.215	0.0	1.693	0.0	0.0	179.9984
3.55	2.870	3.260	0.0	1.716	0.0	0.0	179.9984
3.60	2.915	3.305	0.0	1.739	0.0	0.0	179.9984
3.65	2.960	3.350	0.0	1.762	0.0	0.0	179.9984
3.70	3.005	3.395	0.0	1.785	0.0	0.0	179.9984
3.75	3.050	3.440	0.0	1.808	0.0	0.0	179.9984
3.80	3.095	3.485	0.0	1.831	0.0	0.0	179.9984
3.85	3.140	3.530	0.0	1.854	0.0	0.0	179.9984
3.90	3.185	3.575	0.0	1.877	0.0	0.0	179.9984
3.95	3.230	3.620	0.0	1.900	0.0	0.0	179.9984
4.00	3.275	3.665	0.0	1.923	0.0	0.0	179.9984
4.05	3.320	3.710	0.0	1.946	0.0	0.0	179.9984
4.10	3.365	3.755	0.0	1.969	0.0	0.0	179.9984
4.15	3.410	3.800	0.0	1.992	0.0	0.0	179.9984
4.20	3.455	3.845	0.0	2.015	0.0	0.0	179.9984
4.25	3.500	3.890	0.0	2.038	0.0	0.0	179.9984
4.30	3.545	3.935	0.0	2.061	0.0	0.0	179.9984
4.35	3.590	3.980	0.0	2.084	0.0	0.0	179.9984
4.40	3.635	4.025	0.0	2.107	0.0	0.0	179.9984
4.45	3.680	4.070	0.0	2.130	0.0	0.0	179.9984
4.50	3.725	4.115	0.0	2.153	0.0	0.0	179.9984
4.55	3.770	4.160	0.0	2.176	0.0	0.0	179.9984
4.60	3.815	4.205	0.0	2.199	0.0	0.0	179.9984
4.65	3.860	4.250	0.0	2.222	0.0	0.0	179.9984
4.70	3.905	4.295	0.0	2.245	0.0	0.0	179.9984
4.75	3.950	4.340	0.0	2.268	0.0	0.0	179.9984
4.80	3.995	4.385	0.0	2.291	0.0	0.0	179.9984
4.85	4.040	4.430	0.0	2.314	0.0	0.0	179.9984
4.90	4.085	4.475	0.0	2.337	0.0	0.0	179.9984
4.95	4.130	4.520	0.0	2.360	0.0	0.0	179.9984
5.00	4.175	4.565	0.0	2.383	0.0	0.0	179.9984
5.05	4.220	4.610	0.0	2.406	0.0	0.0	179.9984
5.10	4.265	4.655	0.0	2.429	0.0	0.0	179.9984
5.15	4.310	4.700	0.0	2.452	0.0	0.0	179.9984
5.20	4.355	4.745	0.0	2.475	0.0	0.0	179.9984
5.25	4.400	4.790	0.0	2.498	0.0	0.0	179.9984
5.30	4.445	4.835	0.0	2.521	0.0	0.0	179.9984
5.35	4.490	4.880	0.0	2.544	0.0	0.0	179.9984
5.40	4.535	4.925	0.0	2.567	0.0	0.0	179.9984
5.45	4.580	4.970	0.0	2.590	0.0	0.0	179.9984
5.50	4.625	5.015	0.0	2.613	0.0	0.0	179.9984
5.55	4.670	5.060	0.0	2.636	0.0	0.0	179.9984
5.60	4.715	5.105	0.0	2.659	0.0	0.0	179.9984
5.65	4.760	5.150	0.0	2.682	0.0	0.0	179.9984
5.70	4.805	5.195	0.0	2.705	0.0	0.0	179.9984
5.75	4.850	5.240	0.0	2.728	0.0	0.0	179.9984
5.80	4.895	5.285	0.0	2.751	0.0	0.0	179.9984
5.85	4.940	5.330	0.0	2.774	0.0	0.0	179.9984
5.90	4.985	5.375	0.0	2.797	0.0	0.0	179.9984
5.95	5.030	5.420	0.0	2.820	0.0	0.0	179.9984
6.00	5.075	5.465	0.0	2.843	0.0	0.0	179.9984
6.05	5.120	5.510	0.0	2.866	0.0	0.0	179.9984
6.10	5.165	5.555	0.0	2.889	0.0	0.0	179.9984
6.15	5.210	5.600	0.0	2.912	0.0	0.0	179.9984
6.20	5.255	5.645	0.0	2.935	0.0	0.0	179.9984
6.25	5.300	5.690	0.0	2.958	0.0	0.0	179.9984
6.30	5.345	5.735	0.0	2.981	0.0	0.0	179.9984
6.35	5.390	5.780	0.0	3.004	0.0	0.0	179.9984
6.40	5.435	5.825	0.0	3.027	0.0	0.0	179.9984
6.45	5.480	5.870	0.0	3.050	0.0	0.0	179.9984
6.50	5.525	5.915	0.0	3.073	0.0	0.0	179.9984
6.55	5.570	5.960	0.0	3.096	0.0	0.0	179.9984
6.60	5.615	6.005	0.0	3.119	0.0	0.0	179.9984
6.65	5.660	6.050	0.0	3.142	0.0	0.0	179.9984
6.70	5.705	6.095	0.0	3.165	0.0	0.0	179.9984
6.75	5.750	6.140	0.0	3.188	0.0	0.0	179.9984
6.80	5.795	6.185	0.0	3.211	0.0	0.0	179.9984
6.85	5.840	6.230	0.0	3.234	0.0	0.0	179.9984
6.90	5.885	6.275	0.0	3.257	0.0	0.0	179.9984
6.95	5.930	6.320	0.0	3.280	0.0	0.0	179.9984
7.00	5.975	6.365	0.0	3.303	0.0	0.0	179.9984
7.05	6.020	6.410	0.0	3.326	0.0	0.0	179.9984
7.10	6.065	6.455	0.0	3.349	0.0	0.0	179.9984
7.15	6.110	6.500	0.0	3.372	0.0	0.0	179.9984
7.20	6.155	6.545	0.0	3.395	0.0	0.0	179.9984
7.25	6.200	6.590	0.0	3.418	0.0	0.0	179.9984
7.30	6.245	6.635	0.0	3.441	0.0	0.0	179.9984
7.35	6.290	6.680	0.0	3.464	0.0	0.0	179.9984
7.40	6.335	6.725	0.0	3.487	0.0	0.0	179.9984
7.45	6.380	6.770	0.0	3.510	0.0	0.0	179.9984
7.50	6.425	6.815	0.0	3.533	0.0	0.0	179.9984
7.55	6.470	6.860	0.0	3.556	0.0	0.0	179.9984
7.60	6.515	6.905	0.0	3.579	0.0	0.0	179.9984
7.65	6.560	6.950	0.0	3.602	0.0	0.0	179.9984

Decay of charged kaon to charged pion and neutral pion

Kaon		Decay angle in centre of momentum frame					
		0.0		90.0		179.9999	
in laboratory frame							
P of kaon	T of kaon	P of pion	decay angle	P of pion	decay angle	P of pion	decay angle
0.30	0.084	0.091	180.0	0.254	53.967	0.389	0.000
0.35	0.111	0.077	180.0	0.269	49.680	0.426	0.000
0.40	0.142	0.065	180.0	0.286	45.876	0.463	0.000
0.45	0.174	0.054	180.0	0.304	42.505	0.501	0.000
0.50	0.209	0.043	180.0	0.322	39.517	0.541	0.000
0.55	0.245	0.034	180.0	0.342	36.864	0.581	0.000
0.60	0.283	0.024	180.0	0.362	34.503	0.621	0.000
0.65	0.323	0.016	180.0	0.383	32.395	0.662	0.000
0.70	0.363	0.008	180.0	0.404	30.505	0.704	0.000
0.75	0.404	0.000	180.0	0.426	28.806	0.746	0.000
0.80	0.446	0.007	0.0	0.448	27.272	0.789	0.000
0.85	0.489	0.014	0.0	0.470	25.883	0.831	0.000
0.90	0.533	0.021	0.0	0.492	24.619	0.874	0.000
0.95	0.577	0.028	0.0	0.515	23.467	0.917	0.000
1.00	0.622	0.034	0.0	0.538	22.412	0.961	0.000
1.25	0.850	0.063	0.0	0.655	18.259	1.180	0.000
1.50	1.085	0.090	0.0	0.774	15.373	1.402	0.000
1.75	1.325	0.115	0.0	0.894	13.261	1.626	0.000
2.00	1.566	0.139	0.0	1.016	11.652	1.851	0.000
2.25	1.810	0.162	0.0	1.138	10.387	2.076	0.000
2.50	2.055	0.185	0.0	1.260	9.368	2.302	0.000
2.75	2.300	0.207	0.0	1.383	8.529	2.529	0.000
3.00	2.547	0.229	0.0	1.506	7.828	2.756	0.000
3.25	2.794	0.251	0.0	1.630	7.232	2.983	0.000
3.50	3.041	0.272	0.0	1.753	6.720	3.210	0.000
3.75	3.289	0.294	0.0	1.877	6.276	3.437	0.000
4.00	3.537	0.315	0.0	2.000	5.887	3.664	0.000
4.50	4.033	0.357	0.0	2.248	5.236	4.119	0.000
5.00	4.531	0.399	0.0	2.495	4.715	4.575	0.000
5.50	5.028	0.441	0.0	2.743	4.288	5.030	0.000
6.00	5.527	0.483	0.0	2.991	3.932	5.486	0.000
6.50	6.025	0.524	0.0	3.240	3.630	5.942	0.000
7.00	6.524	0.566	0.0	3.488	3.372	6.398	0.000
7.50	7.023	0.607	0.0	3.736	3.147	6.854	0.000
8.00	7.522	0.649	0.0	3.985	2.951	7.310	0.000
8.50	8.021	0.690	0.0	4.233	2.778	7.766	0.000
9.00	8.520	0.731	0.0	4.481	2.624	8.222	0.000
9.50	9.019	0.772	0.0	4.730	2.486	8.678	0.000
10.00	9.519	0.814	0.0	4.978	2.362	9.135	0.000
10.50	10.018	0.855	0.0	5.227	2.249	9.591	0.000
11.00	10.517	0.896	0.0	5.475	2.147	10.047	0.000
11.50	11.017	0.937	0.0	5.724	2.054	10.503	0.000
12.00	11.516	0.978	0.0	5.972	1.968	10.960	0.000
12.50	12.016	1.019	0.0	6.221	1.890	11.416	0.000
13.00	12.516	1.060	0.0	6.470	1.817	11.872	0.000
13.50	13.015	1.101	0.0	6.718	1.750	12.329	0.000
14.00	13.515	1.143	0.0	6.967	1.687	12.785	0.000
14.50	14.015	1.184	0.0	7.215	1.629	13.241	0.000
15.00	14.514	1.225	0.0	7.464	1.575	13.698	0.000

- Notes (1) F = momentum <GeV/c>, T = kinetic energy <GeV>
(2) All angles are in degree
(3) Decay angle in centre of momentum frame is charged pion decay angle
(4) Momentum and decay angle of neutral pion in laboratory is printed

Table 5.2

Decay of charged kaon to charged muon and neutrino

Kaon Decay angle in centre of momentum frame

0.0 90.0 179.9995

in laboratory frame									
P of kaon	T of kaon	E of muon	decay angle	E of muon	decay angle	P of muon	decay angle		
0.350	0.084	0.432	0.0	0.283	56.335	0.1187	179.3998		
0.355	0.111	0.472	0.0	0.296	52.151	0.1057	175.3558		
0.405	0.142	0.512	0.0	0.315	48.393	0.0940	179.3997		
0.455	0.174	0.554	0.0	0.333	45.027	0.0834	179.3997		
0.505	0.209	0.597	0.0	0.352	42.014	0.0738	179.3997		
0.555	0.243	0.640	0.0	0.372	39.896	0.0650	179.3996		
0.605	0.283	0.684	0.0	0.394	37.820	0.0422	179.3995		
0.655	0.323	0.729	0.0	0.417	36.760	0.0426	179.3995		
0.705	0.363	0.775	0.0	0.435	35.987	0.0362	179.3994		
0.755	0.404	0.821	0.0	0.457	35.381	0.0302	179.3993		
0.805	0.446	0.867	0.0	0.480	34.919	0.0245	179.3991		
0.855	0.489	0.913	0.0	0.503	34.587	0.0191	179.3989		
0.905	0.537	0.960	0.0	0.526	34.367	0.0140	179.3985		
1.250	0.626	1.055	0.0	0.575	24.88	0.0092	179.5977		
1.255	0.655	1.055	0.0	0.595	24.88	0.0125	179.5977		
1.260	0.685	1.055	0.0	0.615	24.88	0.0155	179.5977		
1.265	0.715	1.055	0.0	0.635	24.88	0.0185	179.5977		
1.270	0.745	1.055	0.0	0.655	24.88	0.0215	179.5977		
1.275	0.775	1.055	0.0	0.675	24.88	0.0245	179.5977		
1.280	0.805	1.055	0.0	0.695	24.88	0.0275	179.5977		
1.285	0.835	1.055	0.0	0.715	24.88	0.0305	179.5977		
1.290	0.865	1.055	0.0	0.735	24.88	0.0335	179.5977		
1.295	0.895	1.055	0.0	0.755	24.88	0.0365	179.5977		
1.300	0.925	1.055	0.0	0.775	24.88	0.0395	179.5977		
1.305	0.955	1.055	0.0	0.795	24.88	0.0425	179.5977		
1.310	0.985	1.055	0.0	0.815	24.88	0.0455	179.5977		
1.315	1.015	1.055	0.0	0.835	24.88	0.0485	179.5977		
1.320	1.045	1.055	0.0	0.855	24.88	0.0515	179.5977		
1.325	1.075	1.055	0.0	0.875	24.88	0.0545	179.5977		
1.330	1.105	1.055	0.0	0.895	24.88	0.0575	179.5977		
1.335	1.135	1.055	0.0	0.915	24.88	0.0605	179.5977		
1.340	1.165	1.055	0.0	0.935	24.88	0.0635	179.5977		
1.345	1.195	1.055	0.0	0.955	24.88	0.0665	179.5977		
1.350	1.225	1.055	0.0	0.975	24.88	0.0695	179.5977		
1.355	1.255	1.055	0.0	0.995	24.88	0.0725	179.5977		
1.360	1.285	1.055	0.0	1.015	24.88	0.0755	179.5977		
1.365	1.315	1.055	0.0	1.035	24.88	0.0785	179.5977		
1.370	1.345	1.055	0.0	1.055	24.88	0.0815	179.5977		
1.375	1.375	1.055	0.0	1.075	24.88	0.0845	179.5977		
1.380	1.405	1.055	0.0	1.095	24.88	0.0875	179.5977		
1.385	1.435	1.055	0.0	1.115	24.88	0.0905	179.5977		
1.390	1.465	1.055	0.0	1.135	24.88	0.0935	179.5977		
1.395	1.495	1.055	0.0	1.155	24.88	0.0965	179.5977		
1.400	1.525	1.055	0.0	1.175	24.88	0.0995	179.5977		
1.405	1.555	1.055	0.0	1.195	24.88	0.1025	179.5977		
1.410	1.585	1.055	0.0	1.215	24.88	0.1055	179.5977		
1.415	1.615	1.055	0.0	1.235	24.88	0.1085	179.5977		
1.420	1.645	1.055	0.0	1.255	24.88	0.1115	179.5977		
1.425	1.675	1.055	0.0	1.275	24.88	0.1145	179.5977		
1.430	1.705	1.055	0.0	1.295	24.88	0.1175	179.5977		
1.435	1.735	1.055	0.0	1.315	24.88	0.1205	179.5977		
1.440	1.765	1.055	0.0	1.335	24.88	0.1235	179.5977		
1.445	1.795	1.055	0.0	1.355	24.88	0.1265	179.5977		
1.450	1.825	1.055	0.0	1.375	24.88	0.1295	179.5977		
1.455	1.855	1.055	0.0	1.395	24.88	0.1325	179.5977		
1.460	1.885	1.055	0.0	1.415	24.88	0.1355	179.5977		
1.465	1.915	1.055	0.0	1.435	24.88	0.1385	179.5977		
1.470	1.945	1.055	0.0	1.455	24.88	0.1415	179.5977		
1.475	1.975	1.055	0.0	1.475	24.88	0.1445	179.5977		
1.480	2.005	1.055	0.0	1.495	24.88	0.1475	179.5977		
1.485	2.035	1.055	0.0	1.515	24.88	0.1505	179.5977		
1.490	2.065	1.055	0.0	1.535	24.88	0.1535	179.5977		
1.495	2.095	1.055	0.0	1.555	24.88	0.1565	179.5977		
1.500	2.125	1.055	0.0	1.575	24.88	0.1595	179.5977		
1.505	2.155	1.055	0.0	1.595	24.88	0.1625	179.5977		
1.510	2.185	1.055	0.0	1.615	24.88	0.1655	179.5977		
1.515	2.215	1.055	0.0	1.635	24.88	0.1685	179.5977		
1.520	2.245	1.055	0.0	1.655	24.88	0.1715	179.5977		
1.525	2.275	1.055	0.0	1.675	24.88	0.1745	179.5977		
1.530	2.305	1.055	0.0	1.695	24.88	0.1775	179.5977		
1.535	2.335	1.055	0.0	1.715	24.88	0.1805	179.5977		
1.540	2.365	1.055	0.0	1.735	24.88	0.1835	179.5977		
1.545	2.395	1.055	0.0	1.755	24.88	0.1865	179.5977		
1.550	2.425	1.055	0.0	1.775	24.88	0.1895	179.5977		
1.555	2.455	1.055	0.0	1.795	24.88	0.1925	179.5977		
1.560	2.485	1.055	0.0	1.815	24.88	0.1955	179.5977		
1.565	2.515	1.055	0.0	1.835	24.88	0.1985	179.5977		
1.570	2.545	1.055	0.0	1.855	24.88	0.2015	179.5977		
1.575	2.575	1.055	0.0	1.875	24.88	0.2045	179.5977		
1.580	2.605	1.055	0.0	1.895	24.88	0.2075	179.5977		
1.585	2.635	1.055	0.0	1.915	24.88	0.2105	179.5977		
1.590	2.665	1.055	0.0	1.935	24.88	0.2135	179.5977		
1.595	2.695	1.055	0.0	1.955	24.88	0.2165	179.5977		
1.600	2.725	1.055	0.0	1.975	24.88	0.2195	179.5977		
1.605	2.755	1.055	0.0	1.995	24.88	0.2225	179.5977		
1.610	2.785	1.055	0.0	2.015	24.88	0.2255	179.5977		
1.615	2.815	1.055	0.0	2.035	24.88	0.2285	179.5977		
1.620	2.845	1.055	0.0	2.055	24.88	0.2315	179.5977		
1.625	2.875	1.055	0.0	2.075	24.88	0.2345	179.5977		
1.630	2.905	1.055	0.0	2.095	24.88	0.2375	179.5977		
1.635	2.935	1.055	0.0	2.115	24.88	0.2405	179.5977		
1.640	2.965	1.055	0.0	2.135	24.88	0.2435	179.5977		
1.645	2.995	1.055	0.0	2.155	24.88	0.2465	179.5977		
1.650	3.025	1.055	0.0	2.175	24.88	0.2495	179.5977		
1.655	3.055	1.055	0.0	2.195	24.88	0.2525	179.5977		
1.660	3.085	1.055	0.0	2.215	24.88	0.2555	179.5977		
1.665	3.115	1.055	0.0	2.235	24.88	0.2585	179.5977		
1.670	3.145	1.055	0.0	2.255	24.88	0.2615	179.5977		
1.675	3.175	1.055	0.0	2.275	24.88	0.2645	179.5977		
1.680	3.205	1.055	0.0	2.295	24.88	0.2675	179.5977		
1.685	3.235	1.055	0.0	2.315	24.88	0.2705	179.5977		
1.690	3.265	1.055	0.0	2.335	24.88	0.2735	179.5977		
1.695	3.295	1.055	0.0	2.355	24.88	0.2765	179.5977		
1.700	3.325	1.055	0.0	2.375	24.88	0.2795	179.5977		
1.705	3.355	1.055	0.0	2.395	24.88	0.2825	179.5977		
1.710	3.385	1.055	0.0	2.415	24.88	0.2855	179.5977		
1.715	3.415	1.055	0.0	2.435	24.88	0.2885	179.5977		
1.720	3.445	1.055	0.0	2.455	24.88	0.2915	179.5977		
1.725	3.475	1.055	0.0	2.475	24.88	0.2945	179.5977		
1.730	3.505	1.055	0.0	2.495	24.88	0.2975	179.5977		
1.735	3.535	1.055	0.0	2.515	24.88	0.3005	179.5977		
1.740	3.565	1.055	0.0	2.535	24.88	0.3035	179.5977		
1.745	3.595	1.055	0.0	2.555	24.88	0.3065	179.5977		
1.750	3.625	1.055	0.0	2.575	24.88	0.3095	179.5977		
1.755	3.655	1.055	0.0	2.595	24.88	0.3125	179.5977		
1.760	3.685	1.055	0.0	2.615	24.88	0.3155	179.5977		
1.765	3.715	1.055	0.0	2.635	24.88	0.3185	179.5977		
1.770	3.745	1.055	0.0	2.655	24.88	0.3215	179.5977		
1.775	3.775	1.055	0.0	2.675	24.88	0.3245	179.5977		
1.780	3.805	1.055	0.0	2.695	24.88	0.3275	179.5977		
1.785	3.835	1.055	0.0	2.715	24.88	0.3305	179.5977		
1.790	3.865	1.055	0.0	2.735	24.88	0.3335	179.5977		
1.795	3.895	1.055	0.0	2.755	24.88	0.3365	179.5977		
1.800	3.925	1.055	0.0	2.775	24.88	0.3395	179.5977		
1.805	3.955	1.055	0.0	2.795	24.88	0.3425	179.5977		
1.810	3.985	1.055	0.0	2.815	24.88	0.3455	179.5977		
1.815	4.015	1.055	0.0	2.835	24.88	0.3485	179.5977		
1.820	4.045	1.055	0.0	2.855	24.88	0.3515	179.5977		
1.825	4.075	1.055	0.0	2.875	24.88	0.3545	179.5977		
1.830	4.105	1.055	0.0	2.895	24.88	0.3575	179.5977		
1.835	4.135	1.055	0.0	2.915	24.88	0.3605	179.5977		
1.840	4.165	1.055	0.0	2.935	24.88	0.3635	179.5977		
1.845	4.195	1.055	0.0	2.955	24.88	0.3665	179.5977		
1.850	4.225	1.055	0.0	2.975	24.88	0.3695	179.5977		
1.855	4.255	1.055	0.0	2.995	24.88	0.3725	179.5977		
1.860	4.285	1.055	0.0	3.015	24.88	0.3755	179.5977		
1.865	4.315	1.055	0.0	3.035	24.88	0.3785	179.5977		
1.870	4.345	1.055	0.0	3.055	24.88	0.3815	179.5977		

Decay of charged kaon to charged muon and neutrino

Kaon		Muon decay angle in centre of momentum frame					
		0.0		90.0		179.9999	

in laboratory frame							
P of kaon	T of kaon	P of nu	decay angle	P of nu	decay angle	P of nu	decay angle

0.30	0.084	0.132	180.0	0.276	58.713	0.419	0.0000
0.35	0.111	0.122	180.0	0.289	54.664	0.456	0.0000
0.40	0.142	0.112	180.0	0.303	50.984	0.494	0.0000
0.45	0.174	0.104	180.0	0.319	47.649	0.533	0.0000
0.50	0.209	0.097	180.0	0.335	44.635	0.574	0.0000
0.55	0.245	0.090	180.0	0.353	41.911	0.615	0.0000
0.60	0.283	0.084	180.0	0.371	39.447	0.657	0.0000
0.65	0.323	0.079	180.0	0.389	37.216	0.700	0.0000
0.70	0.363	0.075	180.0	0.409	35.193	0.743	0.0000
0.75	0.404	0.071	180.0	0.428	33.354	0.786	0.0000
0.80	0.446	0.067	180.0	0.448	31.678	0.830	0.0000
0.85	0.489	0.063	180.0	0.469	30.147	0.874	0.0000
0.90	0.533	0.060	180.0	0.490	28.746	0.919	0.0000
0.95	0.577	0.058	180.0	0.511	27.459	0.964	0.0000
1.00	0.622	0.055	180.0	0.532	26.274	1.009	0.0000
1.25	0.850	0.045	180.0	0.641	21.551	1.238	0.0000
1.50	1.085	0.038	180.0	0.753	18.217	1.469	0.0000
1.75	1.325	0.033	180.0	0.868	15.754	1.702	0.0000
2.00	1.566	0.029	180.0	0.983	13.865	1.937	0.0000
2.25	1.810	0.026	180.0	1.099	12.375	2.172	0.0000
2.50	2.055	0.023	180.0	1.216	11.170	2.409	0.0000
2.75	2.300	0.021	180.0	1.333	10.177	2.645	0.0000
3.00	2.547	0.019	180.0	1.451	9.345	2.882	0.0000
3.25	2.794	0.018	180.0	1.568	8.637	3.119	0.0000
3.50	3.041	0.017	180.0	1.686	8.029	3.356	0.0000
3.75	3.289	0.015	180.0	1.805	7.500	3.594	0.0000
4.00	3.537	0.014	180.0	1.923	7.036	3.831	0.0000
4.50	4.033	0.013	180.0	2.160	6.261	4.307	0.0000
5.00	4.531	0.012	180.0	2.397	5.639	4.783	0.0000
5.50	5.028	0.011	180.0	2.635	5.129	5.259	0.0000
6.00	5.527	0.010	180.0	2.872	4.704	5.735	0.0000
6.50	6.025	0.009	180.0	3.110	4.343	6.211	0.0000
7.00	6.524	0.008	180.0	3.348	4.034	6.688	0.0000
7.50	7.023	0.008	180.0	3.586	3.766	7.164	0.0000
8.00	7.522	0.007	180.0	3.824	3.531	7.641	0.0000
8.50	8.021	0.007	180.0	4.062	3.324	8.117	0.0000
9.00	8.520	0.006	180.0	4.300	3.140	8.594	0.0000
9.50	9.019	0.006	180.0	4.539	2.975	9.071	0.0000
10.00	9.519	0.006	180.0	4.777	2.826	9.548	0.0000
10.50	10.018	0.006	180.0	5.015	2.692	10.025	0.0000
11.00	10.517	0.005	180.0	5.253	2.570	10.501	0.0000
11.50	11.017	0.005	180.0	5.492	2.458	10.978	0.0000
12.00	11.516	0.005	180.0	5.730	2.356	11.455	0.0000
12.50	12.016	0.005	180.0	5.968	2.262	11.932	0.0000
13.00	12.516	0.004	180.0	6.207	2.175	12.409	0.0000
13.50	13.015	0.004	180.0	6.445	2.094	12.886	0.0000
14.00	13.515	0.004	180.0	6.683	2.020	13.363	0.0000
14.50	14.015	0.004	180.0	6.922	1.950	13.840	0.0000
15.00	14.514	0.004	180.0	7.160	1.885	14.317	0.0000

- Notes (1) P = momentum <GeV/c>, T = kinetic energy <GeV>
(2) All angles are in degree
(3) nu stands for neutrino
(4) neutrino decay angle in laboratory frame is printed

Table 6.2

Decay of charged pion to charged muon and neutrino

Pion		Decay angle in centre of momentum frame					
		0.0		90.0		179.9999	
		in laboratory frame					
P of pion	T of pion	P of muon	decay angle	P of muon	decay angle	P of muon	decay angle
0.30	0.191	0.307	0.0	0.238	7.195	0.1653	0.0000
0.35	0.237	0.356	0.0	0.277	6.176	0.1949	0.0000
0.40	0.284	0.405	0.0	0.316	5.409	0.2242	0.0000
0.45	0.332	0.455	0.0	0.355	4.811	0.2534	0.0000
0.50	0.380	0.504	0.0	0.394	4.331	0.2825	0.0000
0.55	0.428	0.554	0.0	0.434	3.939	0.3115	0.0000
0.60	0.476	0.603	0.0	0.473	3.612	0.3405	0.0000
0.65	0.525	0.653	0.0	0.512	3.335	0.3694	0.0000
0.70	0.574	0.703	0.0	0.551	3.097	0.3982	0.0000
0.75	0.623	0.753	0.0	0.591	2.891	0.4271	0.0000
0.80	0.673	0.803	0.0	0.630	2.710	0.4559	0.0000
0.85	0.722	0.852	0.0	0.669	2.551	0.4847	0.0000
0.90	0.771	0.902	0.0	0.709	2.410	0.5135	0.0000
0.95	0.821	0.952	0.0	0.748	2.283	0.5423	0.0000
1.00	0.870	1.002	0.0	0.787	2.169	0.5711	0.0000
1.25	1.118	1.252	0.0	0.984	1.735	0.7148	0.0000
1.50	1.367	1.501	0.0	1.180	1.446	0.8583	0.0000
1.75	1.616	1.751	0.0	1.377	1.240	1.0018	0.0000
2.00	1.865	2.001	0.0	1.573	1.085	1.1452	0.0000
2.25	2.115	2.251	0.0	1.770	0.964	1.2886	0.0000
2.50	2.364	2.501	0.0	1.967	0.868	1.4320	0.0000
2.75	2.614	2.751	0.0	2.163	0.789	1.5753	0.0000
3.00	2.864	3.001	0.0	2.360	0.723	1.7187	0.0000
3.25	3.113	3.251	0.0	2.557	0.668	1.8620	0.0000
3.50	3.363	3.501	0.0	2.753	0.620	2.0054	0.0000
3.75	3.613	3.751	0.0	2.950	0.579	2.1487	0.0000
4.00	3.863	4.001	0.0	3.146	0.542	2.2920	0.0000
4.50	4.363	4.500	0.0	3.540	0.482	2.5786	0.0000
5.00	4.862	5.000	0.0	3.933	0.434	2.8652	0.0000
5.50	5.362	5.500	0.0	4.326	0.395	3.1518	0.0000
6.00	5.862	6.000	0.0	4.719	0.362	3.4384	0.0000
6.50	6.362	6.500	0.0	5.113	0.334	3.7250	0.0000
7.00	6.862	7.000	0.0	5.506	0.310	4.0116	0.0000
7.50	7.362	7.500	0.0	5.899	0.289	4.2982	0.0000
8.00	7.862	8.000	0.0	6.293	0.271	4.5848	0.0000
8.50	8.362	8.500	0.0	6.686	0.255	4.8713	0.0000
9.00	8.862	9.000	0.0	7.079	0.241	5.1579	0.0000
9.50	9.361	9.500	0.0	7.472	0.228	5.4445	0.0000
10.00	9.861	10.000	0.0	7.866	0.217	5.7311	0.0000
10.50	10.361	10.500	0.0	8.259	0.207	6.0176	0.0000
11.00	10.861	11.000	0.0	8.652	0.197	6.3042	0.0000
11.50	11.361	11.500	0.0	9.046	0.189	6.5908	0.0000
12.00	11.861	12.000	0.0	9.439	0.181	6.8774	0.0000
12.50	12.361	12.500	0.0	9.832	0.174	7.1639	0.0000
13.00	12.861	13.000	0.0	10.225	0.167	7.4505	0.0000
13.50	13.361	13.500	0.0	10.619	0.161	7.7371	0.0000
14.00	13.861	14.000	0.0	11.012	0.155	8.0236	0.0000
14.50	14.361	14.500	0.0	11.405	0.150	8.3102	0.0000
15.00	14.861	15.000	0.0	11.798	0.145	8.5968	0.0000

Notes (1) P = momentum <GeV/c>, T = kinetic energy <GeV>
(2) All angles are in degree

Table 7.1

Decay of charged pion to charged muon and neutrino

Pion		Muon decay angle in centre of momentum frame					
		0.0		90.0		179.9999	
		in laboratory frame					
P of pion	T of pion	P of nu	decay angle	P of nu	decay angle	P of nu	decay angle
0.30	0.191	0.007	180.0	0.071	24.949	0.1347	0.0000
0.35	0.237	0.006	180.0	0.080	21.740	0.1551	0.0000
0.40	0.284	0.005	180.0	0.090	19.235	0.1758	0.0000
0.45	0.332	0.005	180.0	0.101	17.231	0.1966	0.0000
0.50	0.380	0.004	180.0	0.111	15.596	0.2175	0.0000
0.55	0.428	0.004	180.0	0.121	14.239	0.2385	0.0000
0.60	0.476	0.003	180.0	0.131	13.095	0.2595	0.0000
0.65	0.525	0.003	180.0	0.142	12.118	0.2806	0.0000
0.70	0.574	0.003	180.0	0.152	11.276	0.3018	0.0000
0.75	0.623	0.003	180.0	0.163	10.542	0.3229	0.0000
0.80	0.673	0.003	180.0	0.173	9.896	0.3441	0.0000
0.85	0.722	0.002	180.0	0.184	9.325	0.3653	0.0000
0.90	0.771	0.002	180.0	0.194	8.815	0.3865	0.0000
0.95	0.821	0.002	180.0	0.205	8.358	0.4077	0.0000
1.00	0.870	0.002	180.0	0.216	7.945	0.4289	0.0000
1.25	1.118	0.002	180.0	0.268	6.371	0.5352	0.0000
1.50	1.367	0.001	180.0	0.322	5.316	0.6417	0.0000
1.75	1.616	0.001	180.0	0.375	4.560	0.7482	0.0000
2.00	1.865	0.001	180.0	0.428	3.992	0.8548	0.0000
2.25	2.115	0.001	180.0	0.481	3.549	0.9614	0.0000
2.50	2.364	0.001	180.0	0.534	3.195	1.0680	0.0000
2.75	2.614	0.001	180.0	0.588	2.905	1.1747	0.0000
3.00	2.864	0.001	180.0	0.641	2.664	1.2813	0.0000
3.25	3.113	0.001	180.0	0.694	2.459	1.3880	0.0000
3.50	3.363	0.001	180.0	0.748	2.284	1.4946	0.0000
3.75	3.613	0.001	180.0	0.801	2.131	1.6013	0.0000
4.00	3.863	0.001	180.0	0.854	1.998	1.7080	0.0000
4.50	4.363	0.000	180.0	0.961	1.776	1.9214	0.0000
5.00	4.862	0.000	180.0	1.068	1.599	2.1348	0.0000
5.50	5.362	0.000	180.0	1.174	1.454	2.3482	0.0000
6.00	5.862	0.000	180.0	1.281	1.333	2.5616	0.0000
6.50	6.362	0.000	180.0	1.388	1.230	2.7750	0.0000
7.00	6.862	0.000	180.0	1.494	1.142	2.9884	0.0000
7.50	7.362	0.000	180.0	1.601	1.066	3.2018	0.0000
8.00	7.862	0.000	180.0	1.708	0.999	3.4152	0.0000
8.50	8.362	0.000	180.0	1.814	0.941	3.6287	0.0000
9.00	8.862	0.000	180.0	1.921	0.888	3.8421	0.0000
9.50	9.361	0.000	180.0	2.028	0.842	4.0555	0.0000
10.00	9.861	0.000	180.0	2.135	0.800	4.2689	0.0000
10.50	10.361	0.000	180.0	2.241	0.762	4.4823	0.0000
11.00	10.861	0.000	180.0	2.348	0.727	4.6958	0.0000
11.50	11.361	0.000	180.0	2.455	0.695	4.9092	0.0000
12.00	11.861	0.000	180.0	2.561	0.666	5.1226	0.0000
12.50	12.361	0.000	180.0	2.668	0.640	5.3361	0.0000
13.00	12.861	0.000	180.0	2.775	0.615	5.5495	0.0000
13.50	13.361	0.000	180.0	2.882	0.592	5.7629	0.0000
14.00	13.861	0.000	180.0	2.988	0.571	5.9763	0.0000
14.50	14.361	0.000	180.0	3.095	0.551	6.1898	0.0000
15.00	14.861	0.000	180.0	3.202	0.533	6.4032	0.0000

Notes (1) P = momentum <GeV/c>, T = kinetic energy <GeV>
(2) All angles are in degree
(3) nu stands for neutrino
(4) neutrino decay angle in laboratory frame is printed

Table 7.2

The fraction of pions (F_{π}) and the fraction of kaons (F_K)
that survive a drift and the ratio F_{π} / F_K

Drift Length (m)	GeV/c	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4
10	F_{π}	0.699	0.742								
	F_K	0.070	0.109								
	F_{π}/F_K	10.02	6.82								
11	F_{π}	0.675	0.720	0.755	0.782						
	F_K	0.053	0.087	0.123	0.160						
	F_{π}/F_K	12.61	8.27	6.11	4.88						
12	F_{π}	0.651	0.699	0.736	0.765	0.788	0.807				
	F_K	0.041	0.070	0.102	0.136	0.170	0.202				
	F_{π}/F_K	15.88	10.02	7.21	5.63	4.65	3.99				
13	F_{π}	0.628	0.679	0.717	0.748	0.772	0.793	0.809	0.824		
	F_K	0.031	0.056	0.084	0.115	0.146	0.177	0.207	0.236		
	F_{π}/F_K	20.00	12.14	8.50	6.50	5.28	4.47	3.90	3.48		
14	F_{π}	0.606	0.659	0.699	0.731	0.757	0.779	0.796	0.812	0.825	0.836
	F_K	0.024	0.045	0.070	0.097	0.126	0.155	0.184	0.212	0.239	0.264
	F_{π}/F_K	25.18	14.71	10.02	7.51	6.00	5.02	4.33	3.84	3.53	3.17
15	F_{π}	0.585	0.639	0.682	0.715	0.742	0.765	0.784	0.800	0.814	0.826
	F_K	0.018	0.036	0.058	0.084	0.109	0.136	0.163	0.189	0.216	0.240
	F_{π}/F_K	31.71	17.82	11.81	8.67	6.82	5.63	4.81	4.22	3.78	3.44
16	F_{π}	0.564	0.621	0.664	0.699	0.728	0.751	0.771	0.788	0.802	0.815
	F_K	0.014	0.029	0.048	0.070	0.094	0.119	0.144	0.170	0.194	0.218
	F_{π}/F_K	39.93	21.60	13.92	10.02	7.75	6.32	5.34	4.65	4.13	3.73
17	F_{π}	0.544	0.602	0.648	0.684	0.713	0.738	0.759	0.776	0.791	0.805
	F_K	0.011	0.023	0.039	0.059	0.081	0.104	0.128	0.152	0.175	0.199
	F_{π}/F_K	50.27	26.17	16.41	11.57	8.81	7.09	5.93	5.12	4.51	4.60
18	F_{π}	0.525	0.585	0.631	0.669	0.699	0.725	0.746	0.765	0.781	0.795
	F_K	0.008	0.018	0.033	0.050	0.070	0.091	0.113	0.136	0.158	0.181
	F_{π}/F_K	63.29	31.71	19.35	13.36	10.02	7.96	6.59	5.63	4.93	4.40
19	F_{π}	0.506	0.568	0.615	0.654	0.686	0.712	0.734	0.753	0.770	0.785
	F_K	0.006	0.015	0.027	0.042	0.060	0.080	0.100	0.122	0.143	0.164
	F_{π}/F_K	79.69	38.43	22.81	15.43	11.39	8.93	7.32	6.20	5.39	4.78
20	F_{π}	0.489	0.551	0.600	0.639	0.672	0.699	0.722	0.742	0.759	0.775
	F_K	0.005	0.012	0.022	0.036	0.052	0.070	0.089	0.109	0.129	0.149
	F_{π}/F_K	100.41	46.53	26.89	17.82	12.94	10.02	8.12	6.82	5.89	5.19

Table 8.1

The fraction of pions (F_{π}) and the fraction of kaons (F_K) that survive a drift and the ratio F_{π} / F_K											
Drift Length (m)	GeV/c	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7
13	F_{π}	0.748	0.772	0.793	0.809	0.824					
	F_K	0.115	0.146	0.177	0.207	0.236					
	F_{π}/F_K	6.50	5.28	4.47	3.90	3.48					
14	F_{π}	0.731	0.757	0.779	0.796	0.812	0.825	0.836			
	F_K	0.097	0.126	0.155	0.184	0.212	0.239	0.264			
	F_{π}/F_K	7.51	6.00	5.02	4.33	3.84	3.53	3.17			
15	F_{π}	0.715	0.742	0.765	0.784	0.800	0.814	0.826	0.836	0.846	
	F_K	0.084	0.109	0.136	0.163	0.189	0.216	0.240	0.264	0.287	
	F_{π}/F_K	8.67	6.82	5.63	4.81	4.22	3.78	3.44	3.17	2.95	
16	F_{π}	0.699	0.728	0.751	0.771	0.788	0.802	0.815	0.826	0.836	0.845
	F_K	0.070	0.094	0.119	0.144	0.170	0.194	0.218	0.242	0.264	0.286
	F_{π}/F_K	10.02	7.75	6.32	5.34	4.65	4.13	3.73	3.42	3.17	2.96
17	F_{π}	0.684	0.713	0.738	0.759	0.776	0.791	0.805	0.817	0.827	0.836
	F_K	0.059	0.081	0.104	0.128	0.152	0.175	0.199	0.221	0.243	0.264
	F_{π}/F_K	11.57	8.81	7.09	5.93	5.12	4.51	4.60	3.69	3.40	3.17
18	F_{π}	0.669	0.699	0.725	0.746	0.765	0.781	0.795	0.807	0.818	0.827
	F_K	0.050	0.070	0.091	0.113	0.136	0.158	0.181	0.202	0.224	0.244
	F_{π}/F_K	13.36	10.02	7.96	6.59	5.63	4.93	4.40	3.99	3.66	3.39
19	F_{π}	0.654	0.686	0.712	0.734	0.753	0.770	0.785	0.797	0.809	0.819
	F_K	0.042	0.060	0.080	0.100	0.122	0.143	0.164	0.185	0.206	0.226
	F_{π}/F_K	15.43	11.39	8.93	7.32	6.20	5.39	4.78	4.30	3.22	3.62
20	F_{π}	0.639	0.672	0.699	0.722	0.742	0.759	0.775	0.788	0.800	0.810
	F_K	0.036	0.052	0.070	0.089	0.109	0.129	0.149	0.170	0.189	0.209
	F_{π}/F_K	17.82	12.94	10.02	8.12	6.82	5.89	5.19	4.65	4.22	3.88
21	F_{π}	0.625	0.659	0.687	0.711	0.731	0.749	0.765	0.779	0.791	0.802
	F_K	0.030	0.045	0.061	0.079	0.097	0.116	0.136	0.155	0.174	0.193
	F_{π}/F_K	20.58	14.71	11.24	9.02	7.51	6.43	5.63	5.02	4.54	4.15
22	F_{π}		0.646	0.675	0.699	0.720	0.739	0.755	0.769	0.782	0.793
	F_K		0.039	0.053	0.070	0.087	0.105	0.123	0.142	0.160	0.179
	F_{π}/F_K		16.71	12.61	10.02	8.27	7.03	6.11	5.42	4.88	4.44
23	F_{π}				0.688	0.710	0.729	0.745	0.760	0.773	0.785
	F_K				0.062	0.078	0.095	0.112	0.130	0.148	0.165
	F_{π}/F_K				11.12	9.10	7.68	6.64	5.85	5.24	4.75

Table 8.2

The fraction of pions (F_{π}) and the fraction of kaons (F_K) that survive a drift and the ratio F_{π} / F_K											
Drift Length (m)	GeV/c	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
17	F_{π}	0.759	0.776	0.791	0.805	0.817	0.827	0.836	0.845	0.852	0.859
	F_K	0.128	0.152	0.175	0.199	0.221	0.243	0.264	0.284	0.304	0.323
	F_{π}/F_K	5.93	5.12	4.51	4.60	3.69	3.40	3.17	2.97	2.80	2.66
18	F_{π}	0.746	0.765	0.781	0.795	0.807	0.818	0.827	0.836	0.844	0.851
	F_K	0.113	0.136	0.158	0.181	0.202	0.224	0.244	0.264	0.283	0.302
	F_{π}/F_K	6.59	5.63	4.93	4.40	3.99	3.66	3.39	3.17	2.98	2.82
19	F_{π}	0.734	0.753	0.770	0.785	0.797	0.809	0.819	0.828	0.836	0.844
	F_K	0.100	0.122	0.143	0.164	0.185	0.206	0.226	0.245	0.264	0.282
	F_{π}/F_K	7.32	6.20	5.39	4.78	4.30	3.22	3.62	3.37	3.17	2.96
20	F_{π}	0.722	0.742	0.759	0.775	0.788	0.800	0.810	0.820	0.828	0.836
	F_K	0.089	0.109	0.129	0.149	0.170	0.189	0.209	0.228	0.246	0.264
	F_{π}/F_K	8.12	6.82	5.89	5.19	4.65	4.22	3.88	3.60	3.36	3.17
21	F_{π}	0.711	0.731	0.749	0.765	0.779	0.791	0.802	0.812	0.821	0.829
	F_K	0.079	0.097	0.116	0.136	0.155	0.174	0.193	0.212	0.230	0.247
	F_{π}/F_K	9.02	7.51	6.43	5.63	5.02	4.54	4.15	3.84	3.57	3.35
22	F_{π}	0.699	0.720	0.739	0.755	0.769	0.782	0.793	0.804	0.813	0.821
	F_K	0.070	0.087	0.105	0.123	0.142	0.160	0.179	0.197	0.214	0.231
	F_{π}/F_K	10.02	8.27	7.03	6.11	5.42	4.88	4.44	4.09	3.80	3.55
23	F_{π}	0.688	0.710	0.729	0.745	0.760	0.773	0.785	0.796	0.805	0.814
	F_K	0.062	0.078	0.095	0.112	0.130	0.148	0.165	0.183	0.200	0.216
	F_{π}/F_K	11.12	9.10	7.68	6.64	5.85	5.24	4.75	4.16	4.03	3.76
24	F_{π}			0.719	0.736	0.751	0.765	0.777	0.788	0.798	0.807
	F_K			0.086	0.102	0.119	0.136	0.153	0.170	0.186	0.202
	F_{π}/F_K			8.39	7.21	6.32	5.63	5.09	4.65	4.29	3.99
25	F_{π}					0.742	0.756	0.769	0.780	0.790	0.800
	F_K					0.109	0.125	0.141	0.157	0.174	0.189
	F_{π}/F_K					6.82	6.05	5.44	4.95	4.55	4.22
26	F_{π}							0.761	0.772	0.783	0.793
	F_K							0.131	0.146	0.162	0.177
	F_{π}/F_K							5.82	5.28	4.84	4.47
27	F_{π}									0.776	0.786
	F_K									0.151	0.166
	F_{π}/F_K									5.14	4.74

Table 8.3

Fig. 4.1

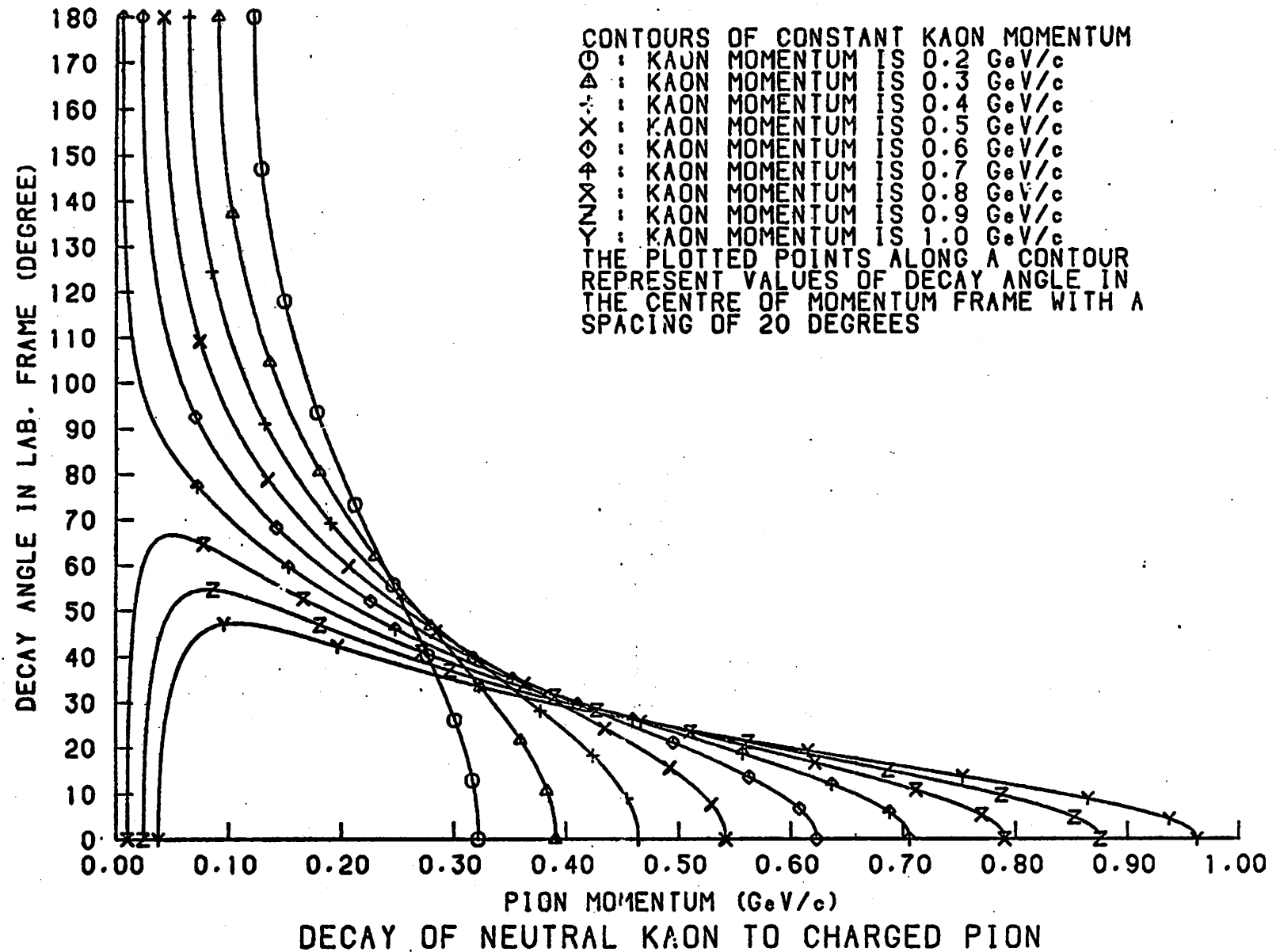


Fig. 4.2

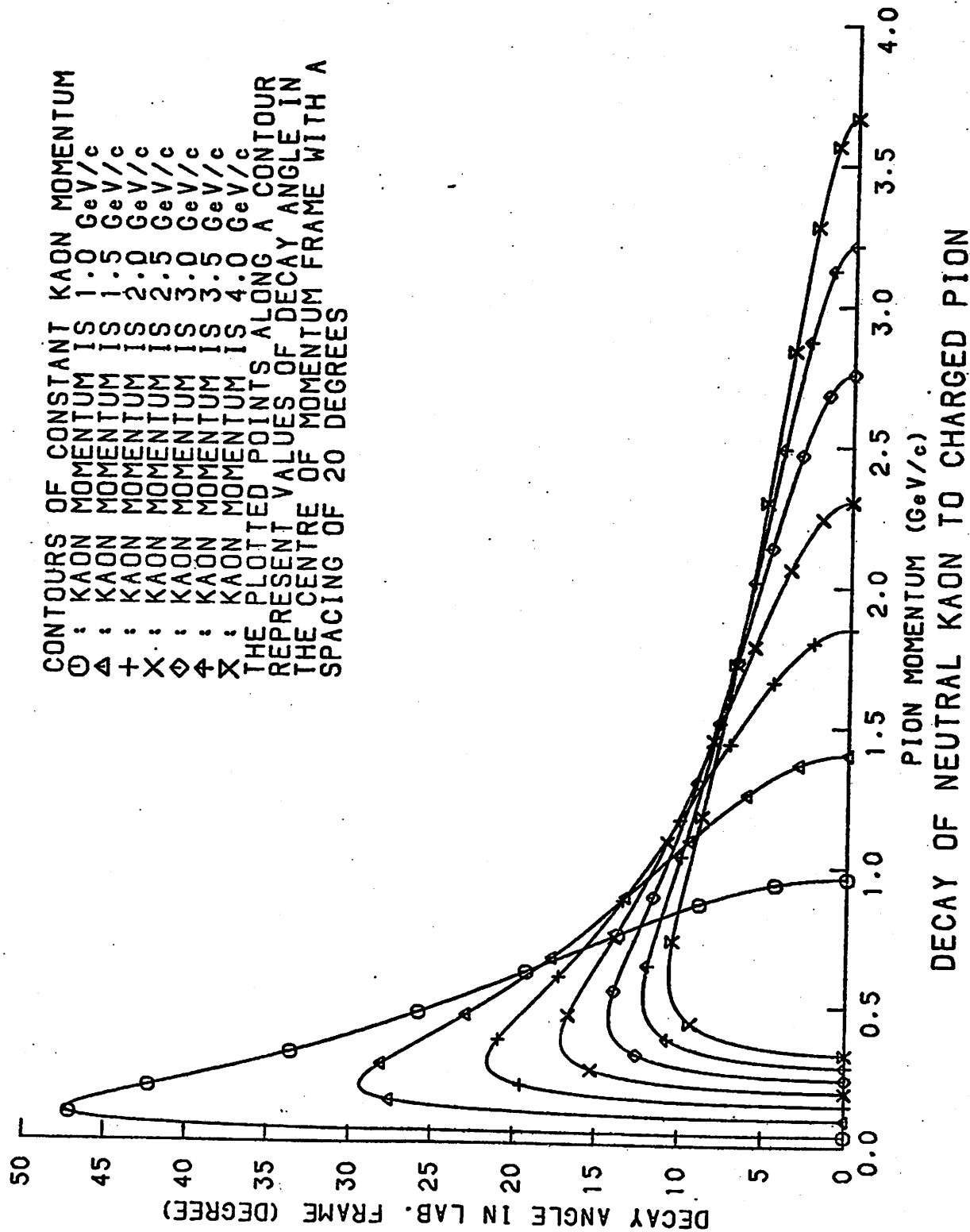


Fig. 4.3

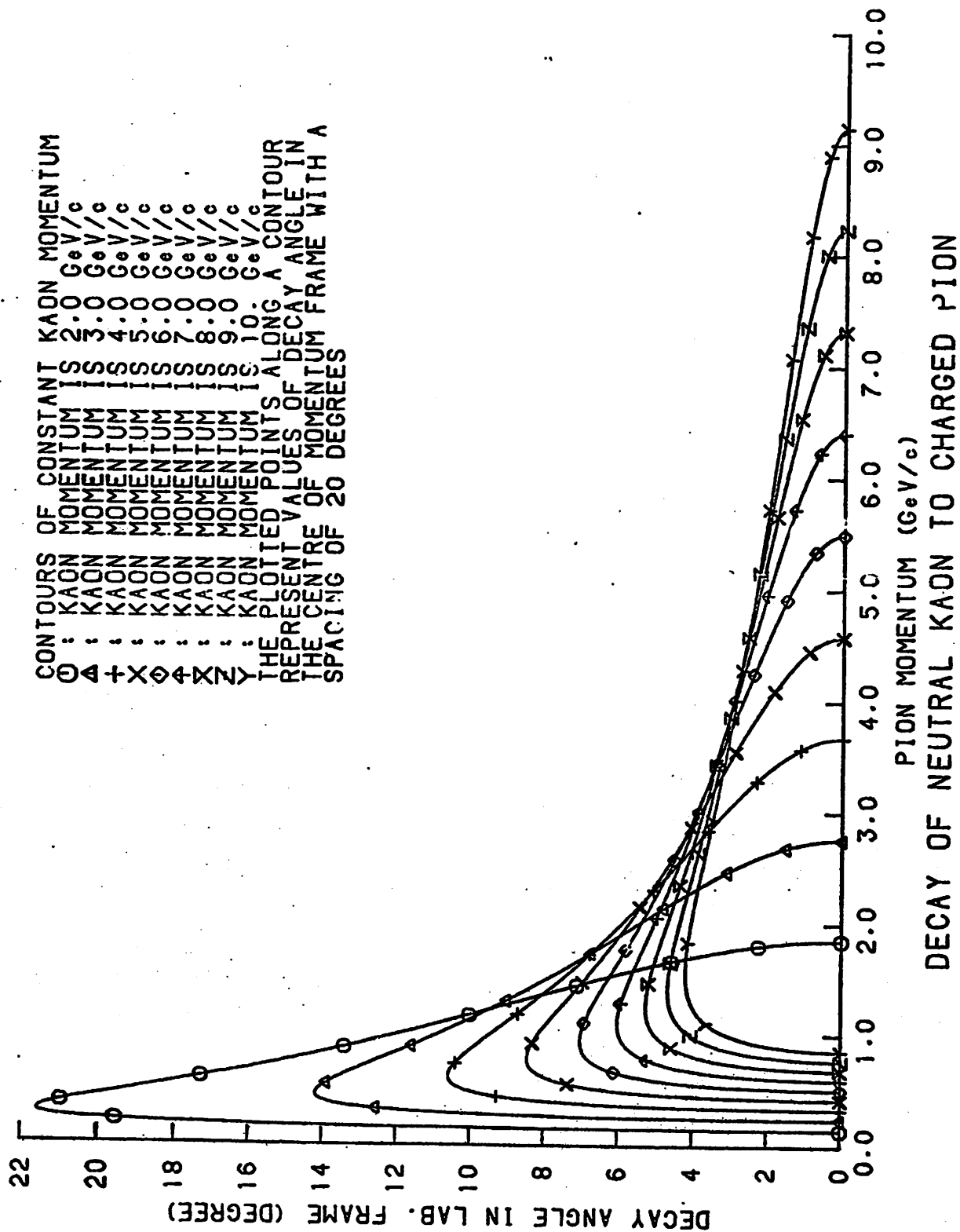


Fig. 5.1

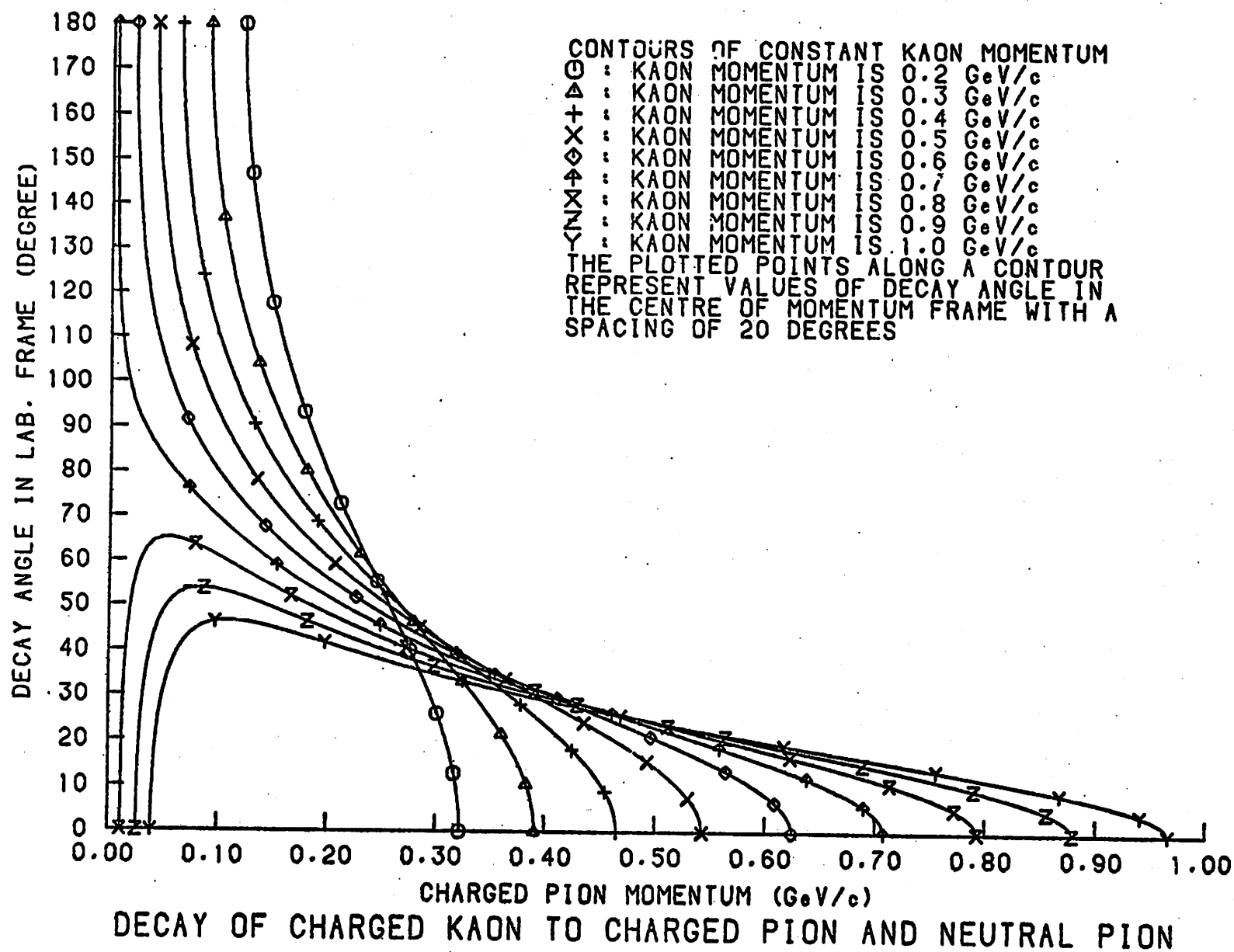


Fig. 5.2

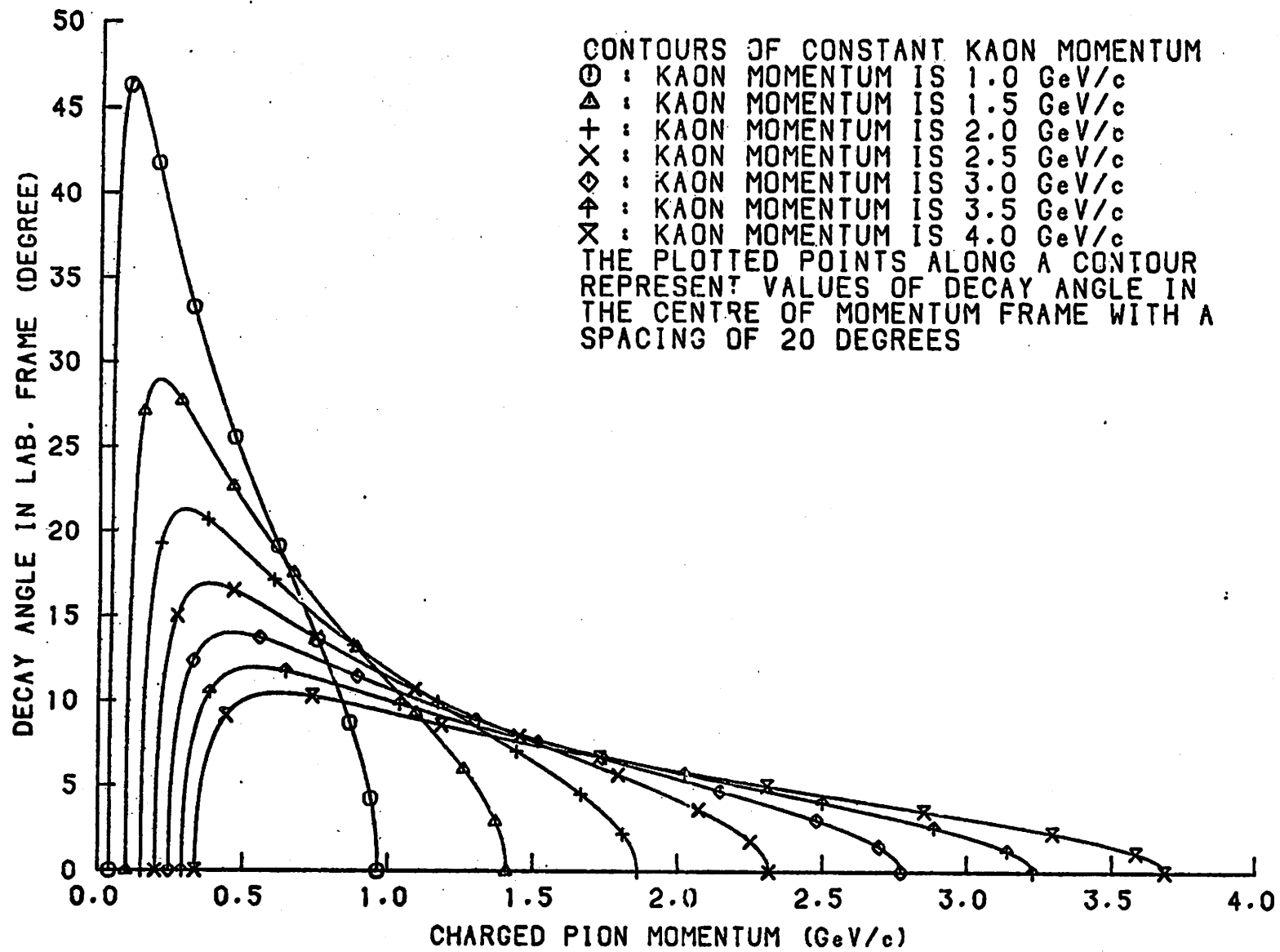
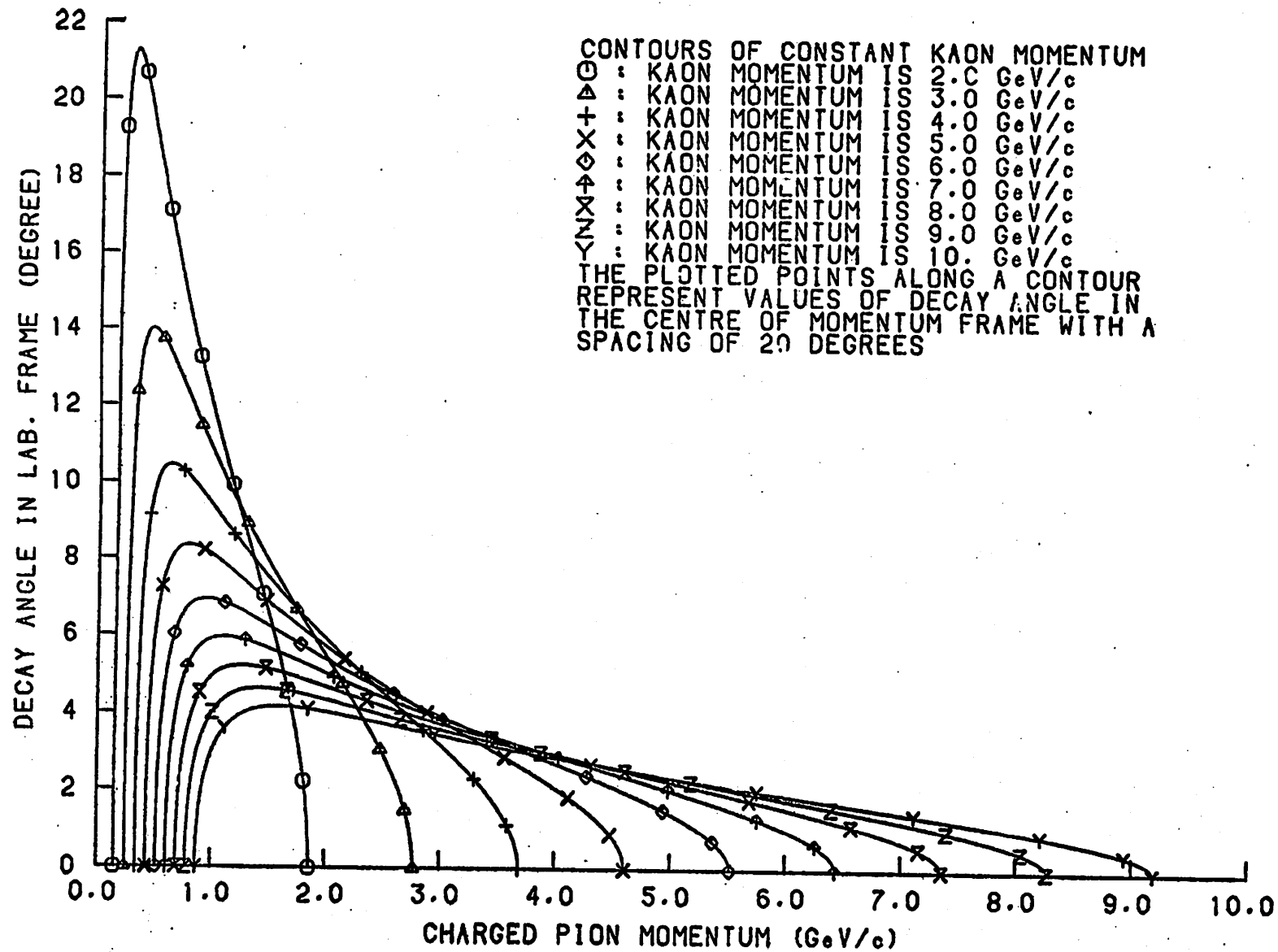


Fig. 5.3



DECAY OF CHARGED KAON TO CHARGED PION AND NEUTRAL PION

Fig. 5.4

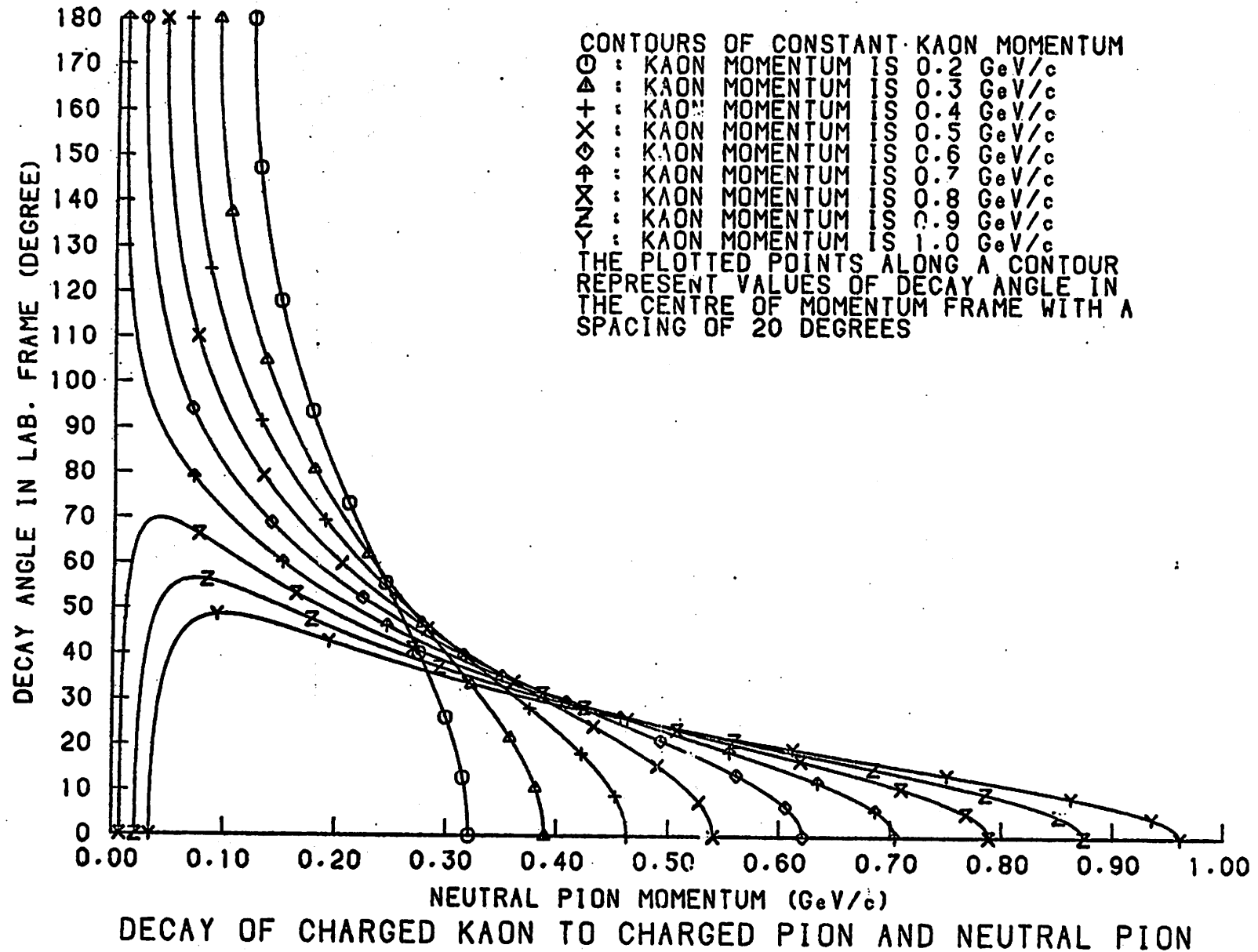


Fig. 5.5

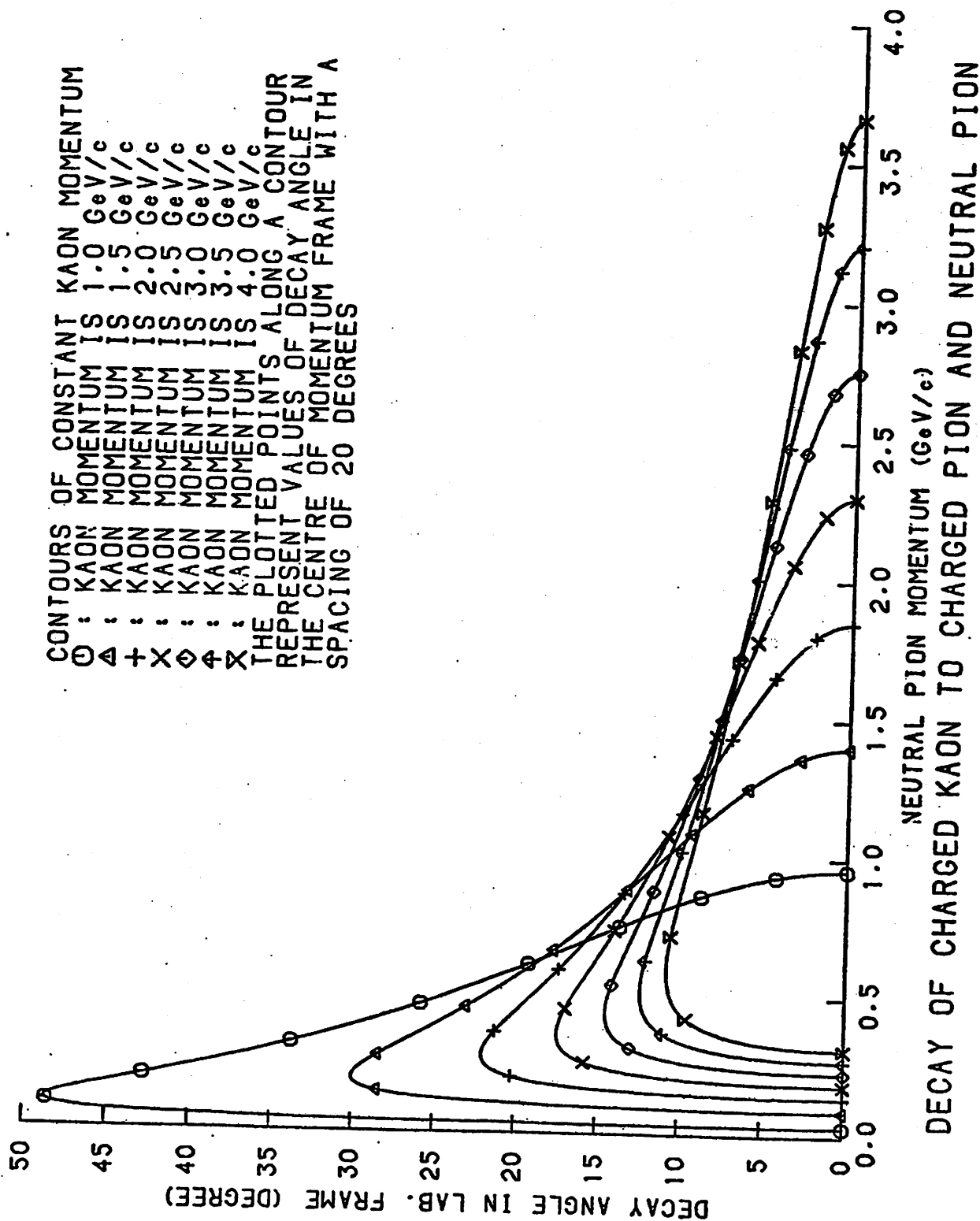


Fig. 5.6

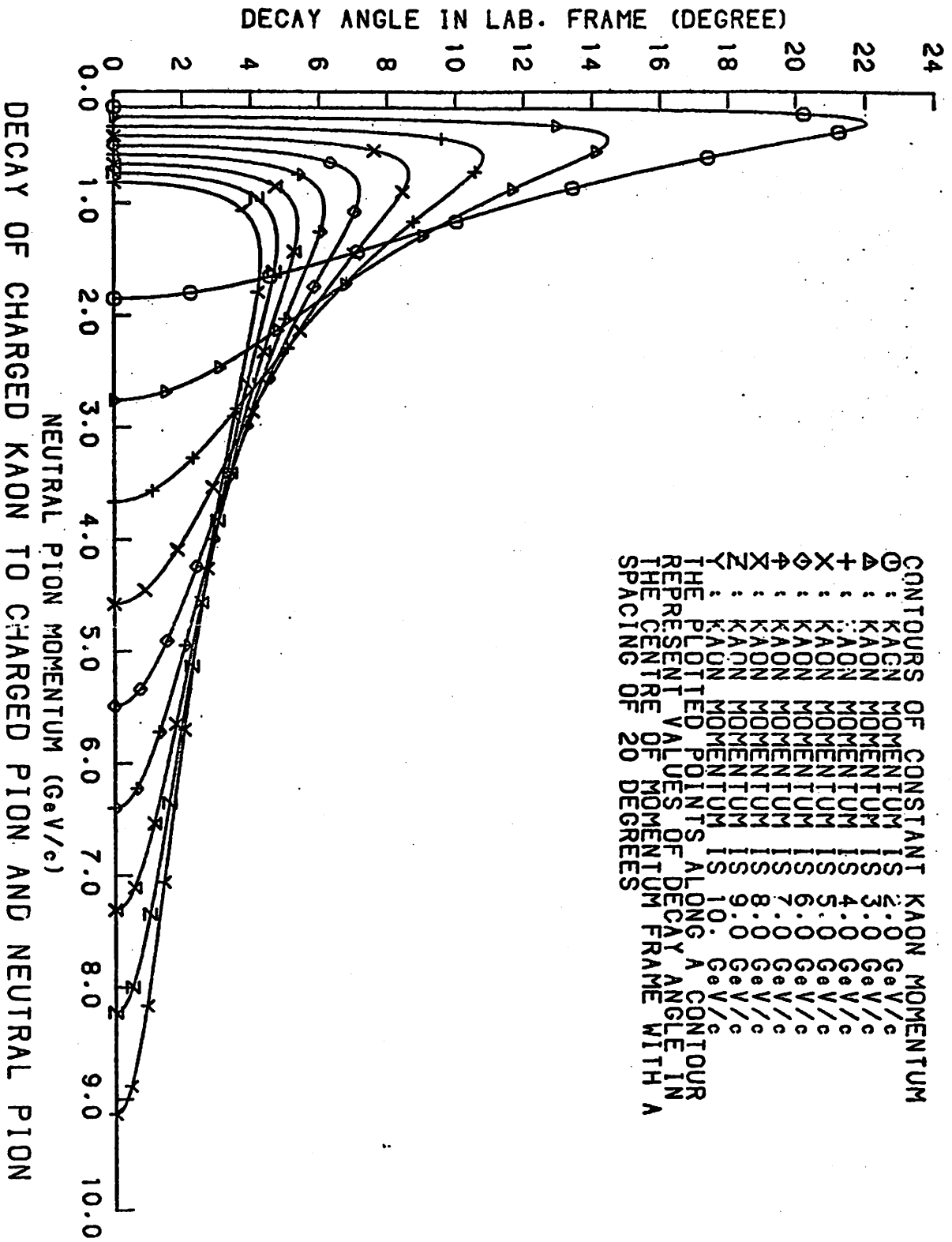


Fig. 6.1

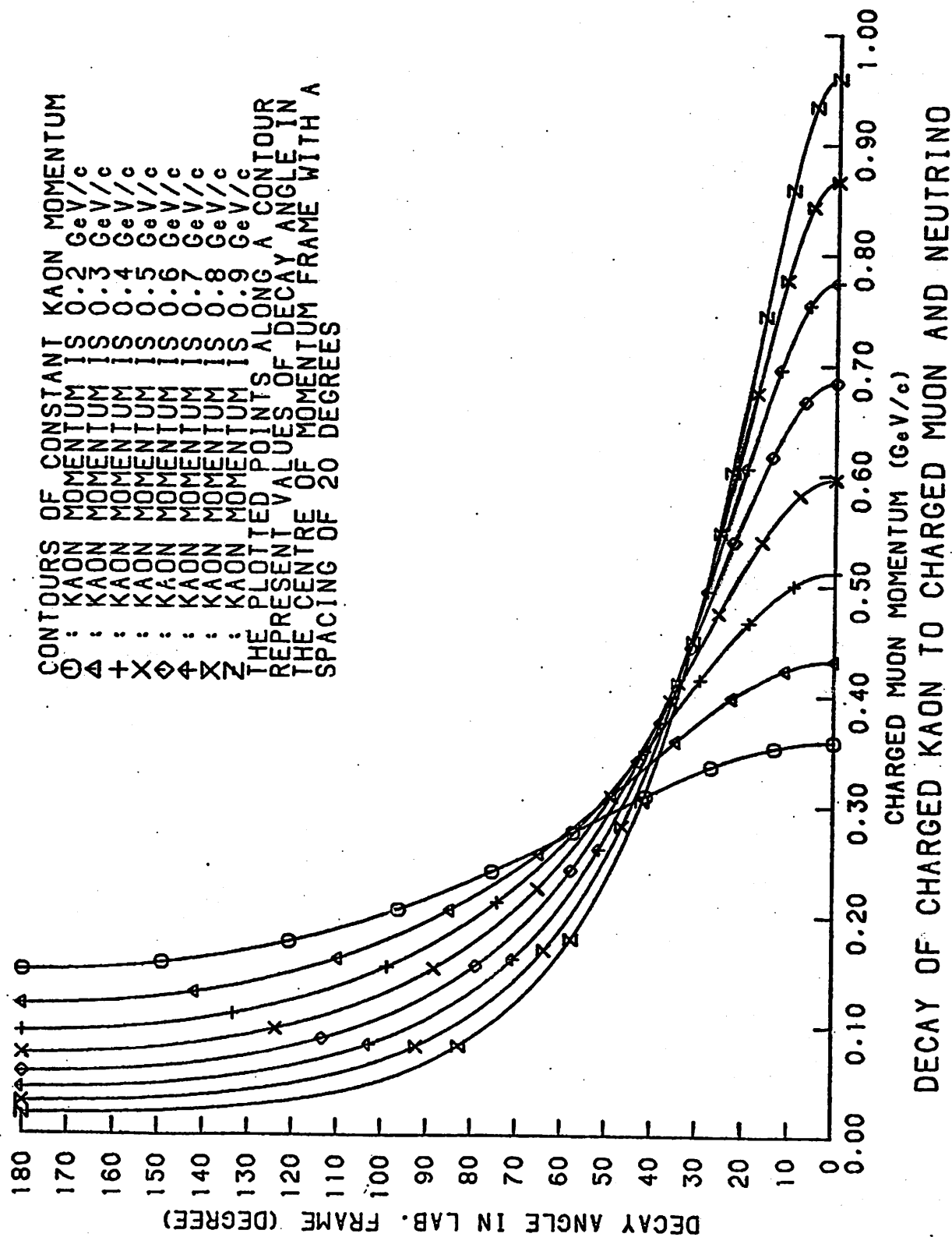
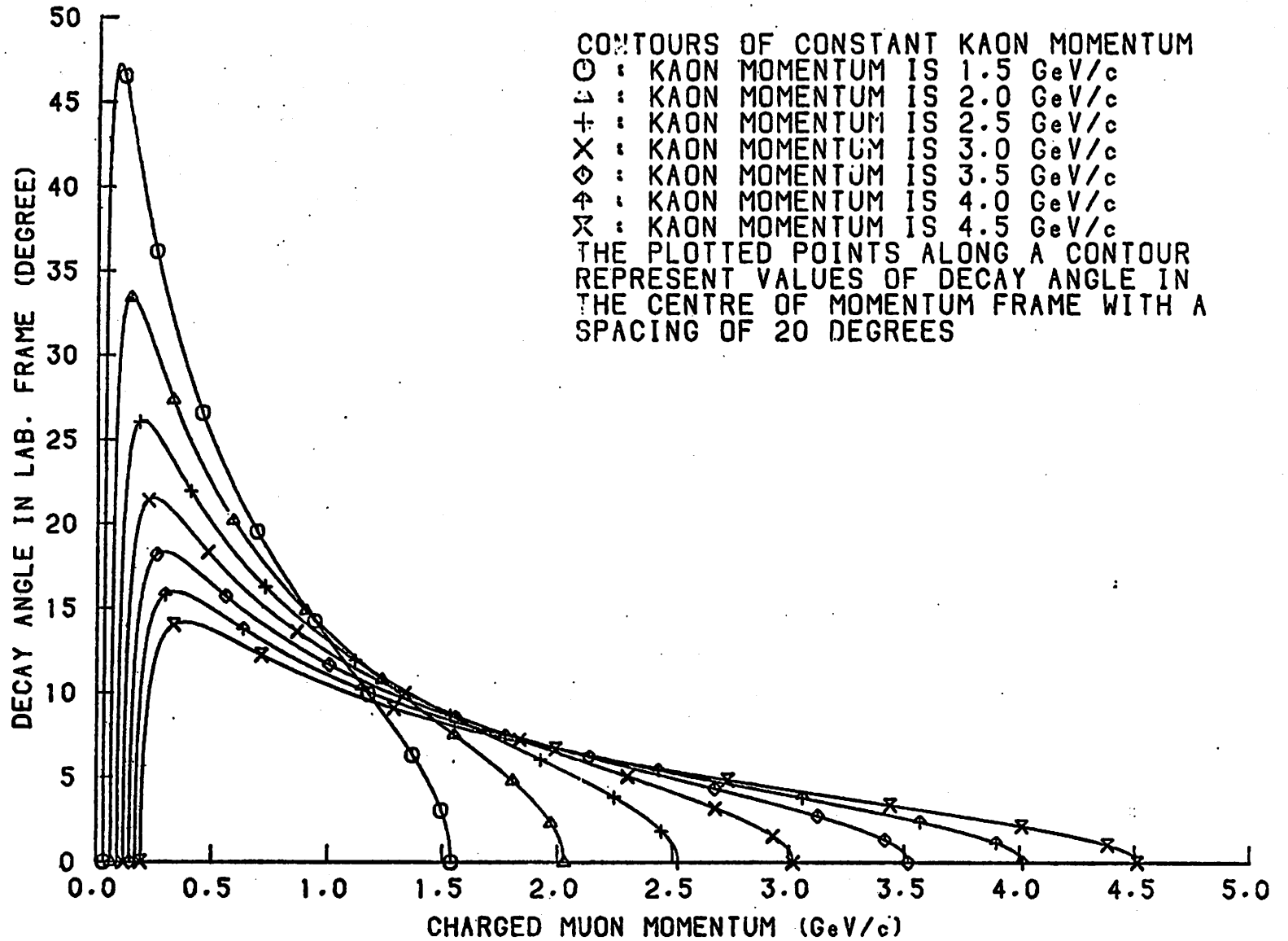


Fig. 6.2



DECAY OF CHARGED KAON TO CHARGED MUON AND NEUTRINO

Fig. 6.3

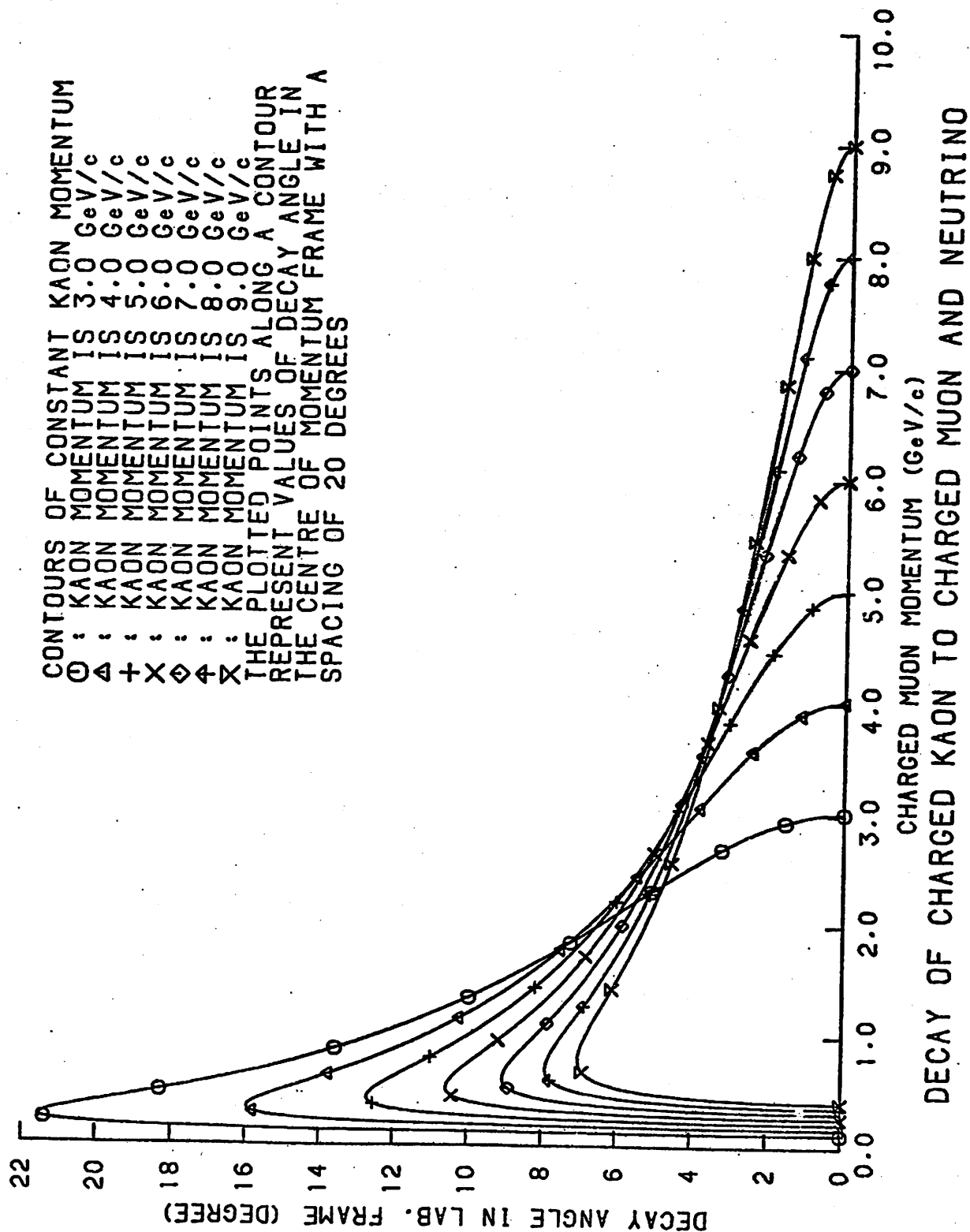


Fig. 6.4

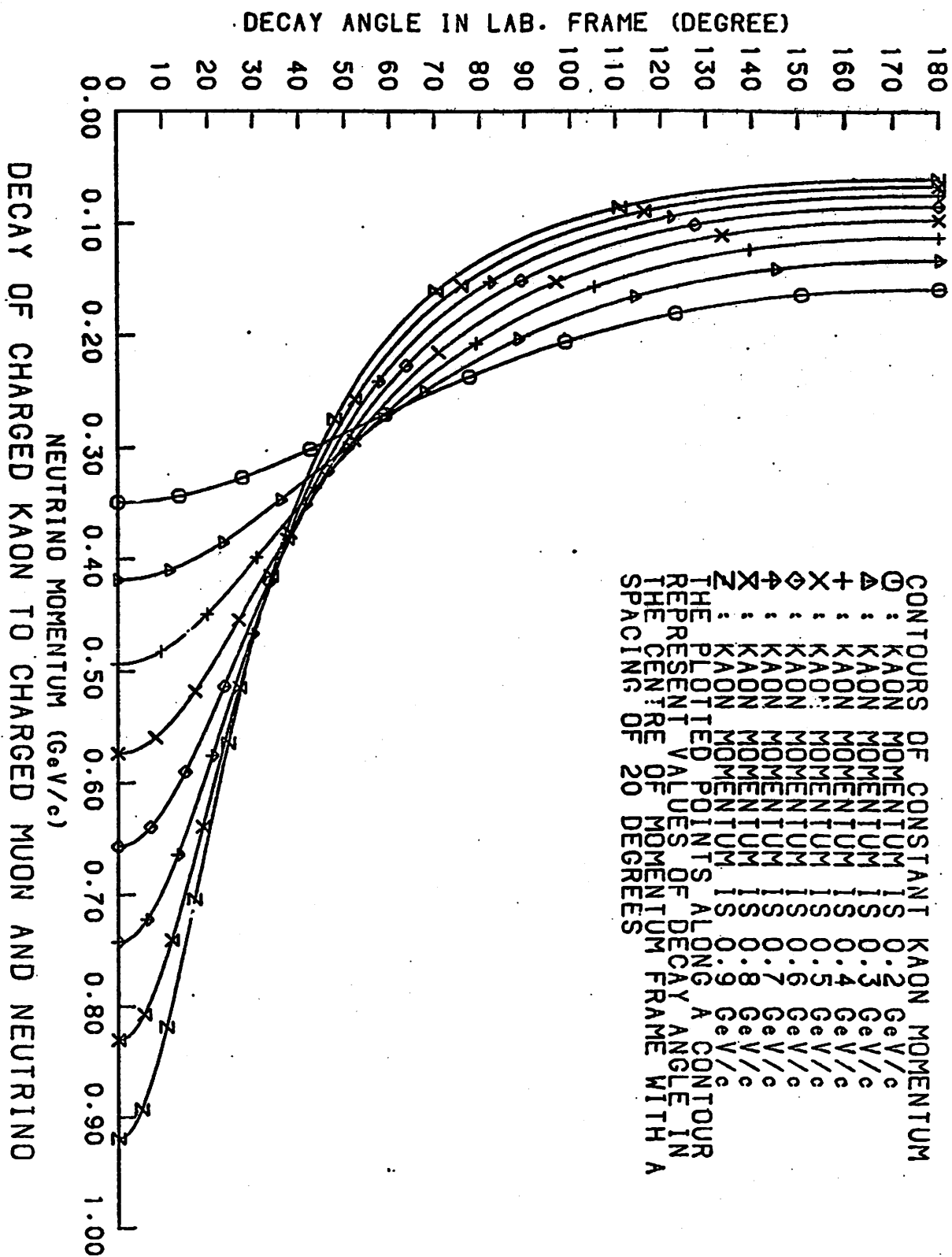


Fig. 6.5

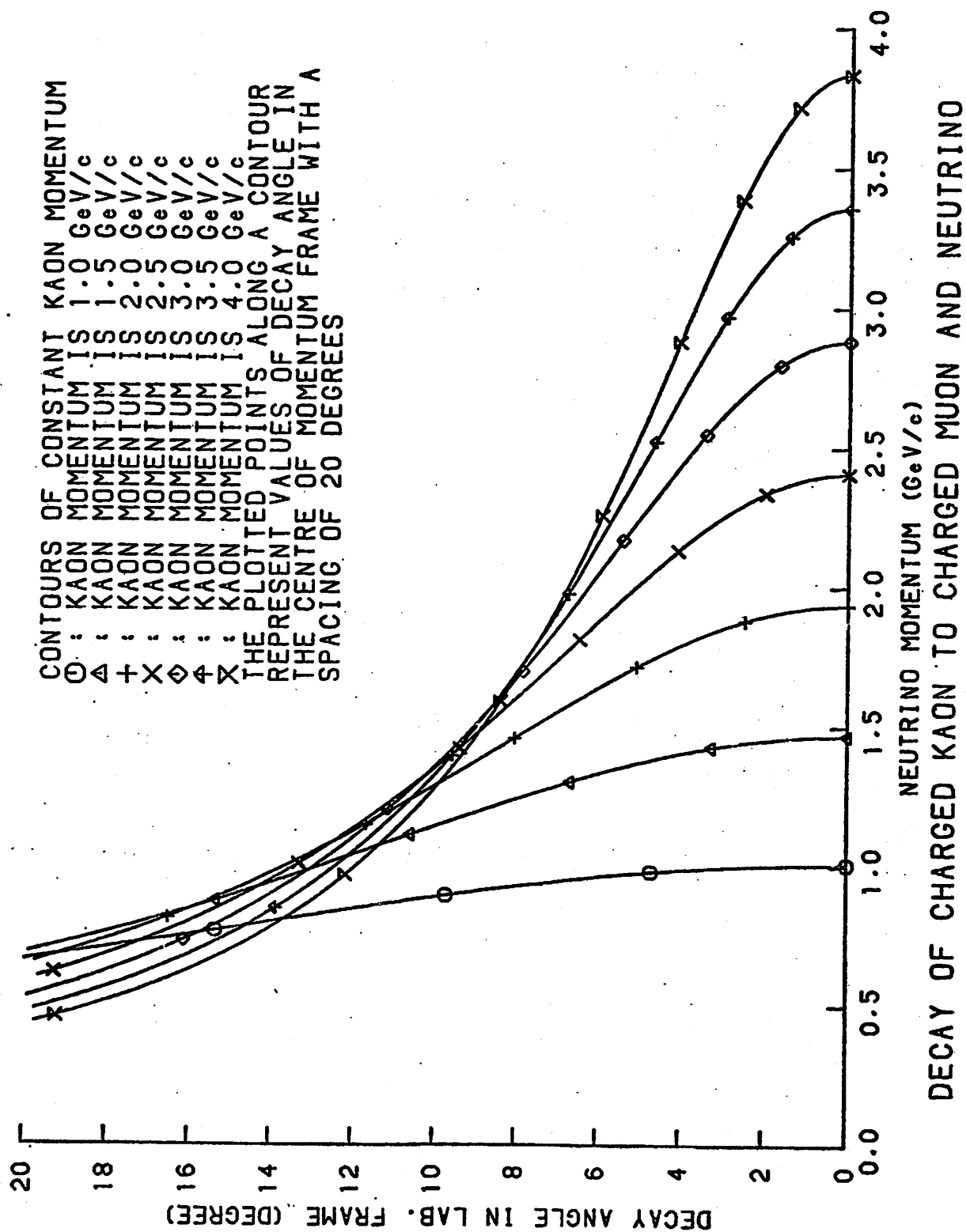


Fig. 6.6

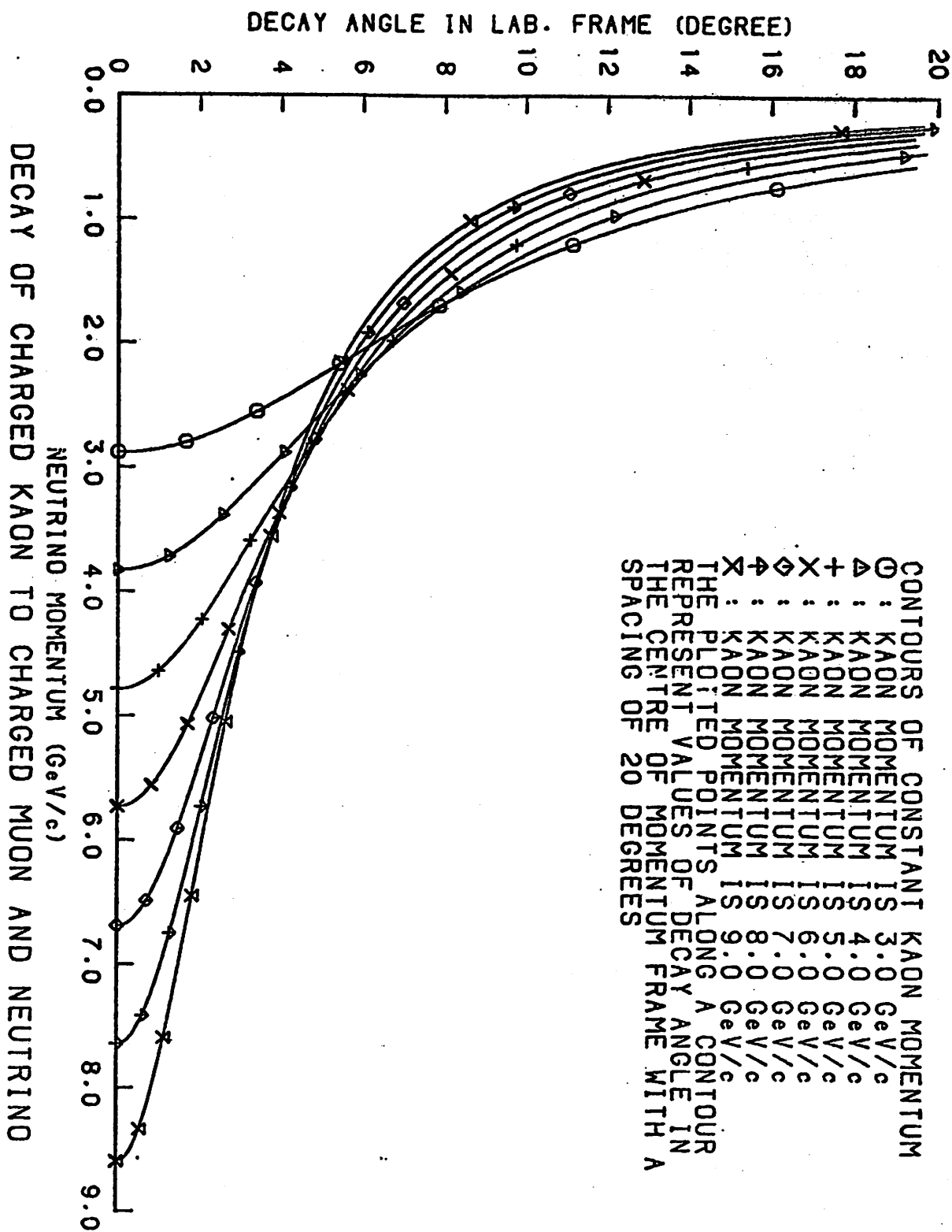


Fig. 7.1

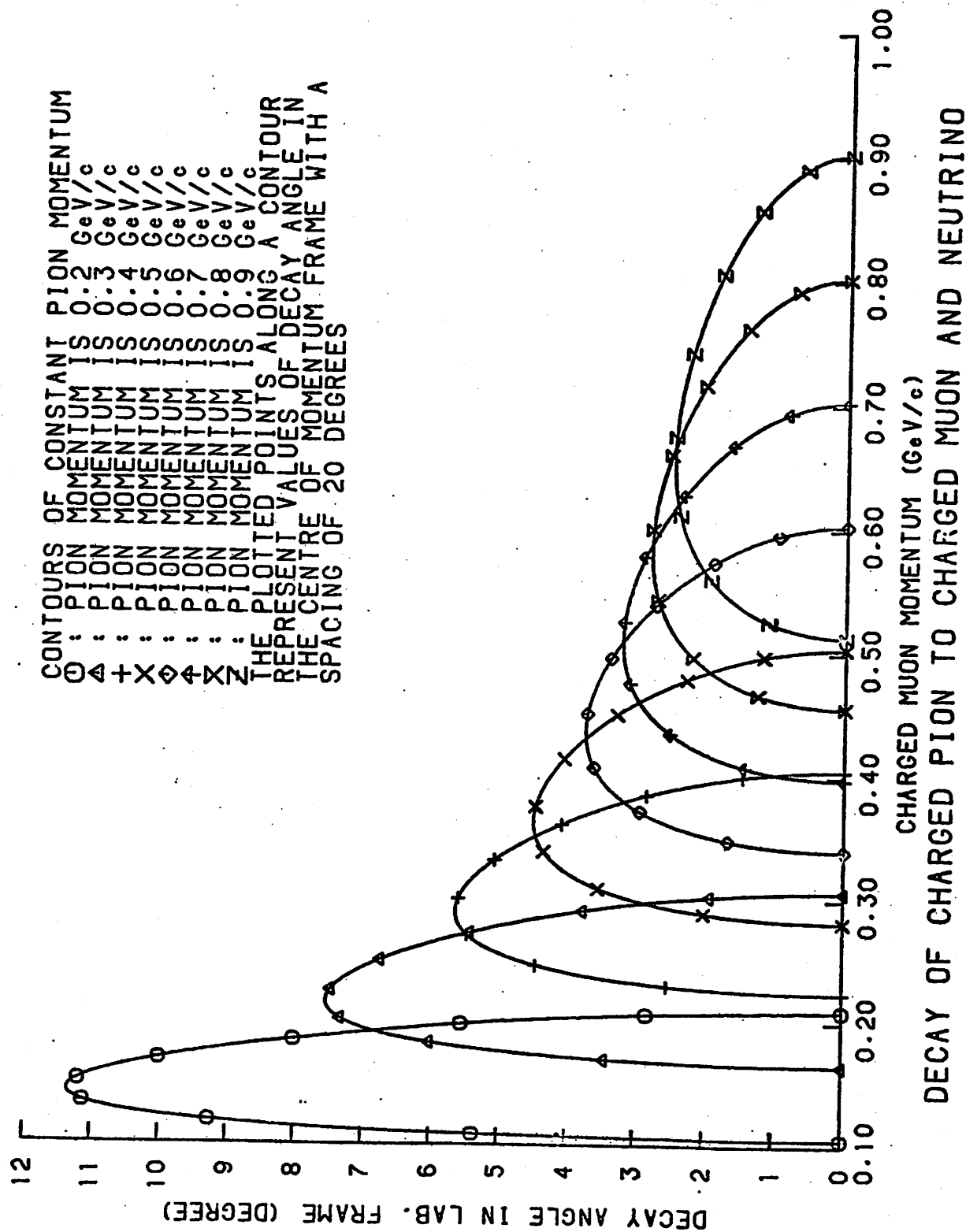


Fig. 7.2

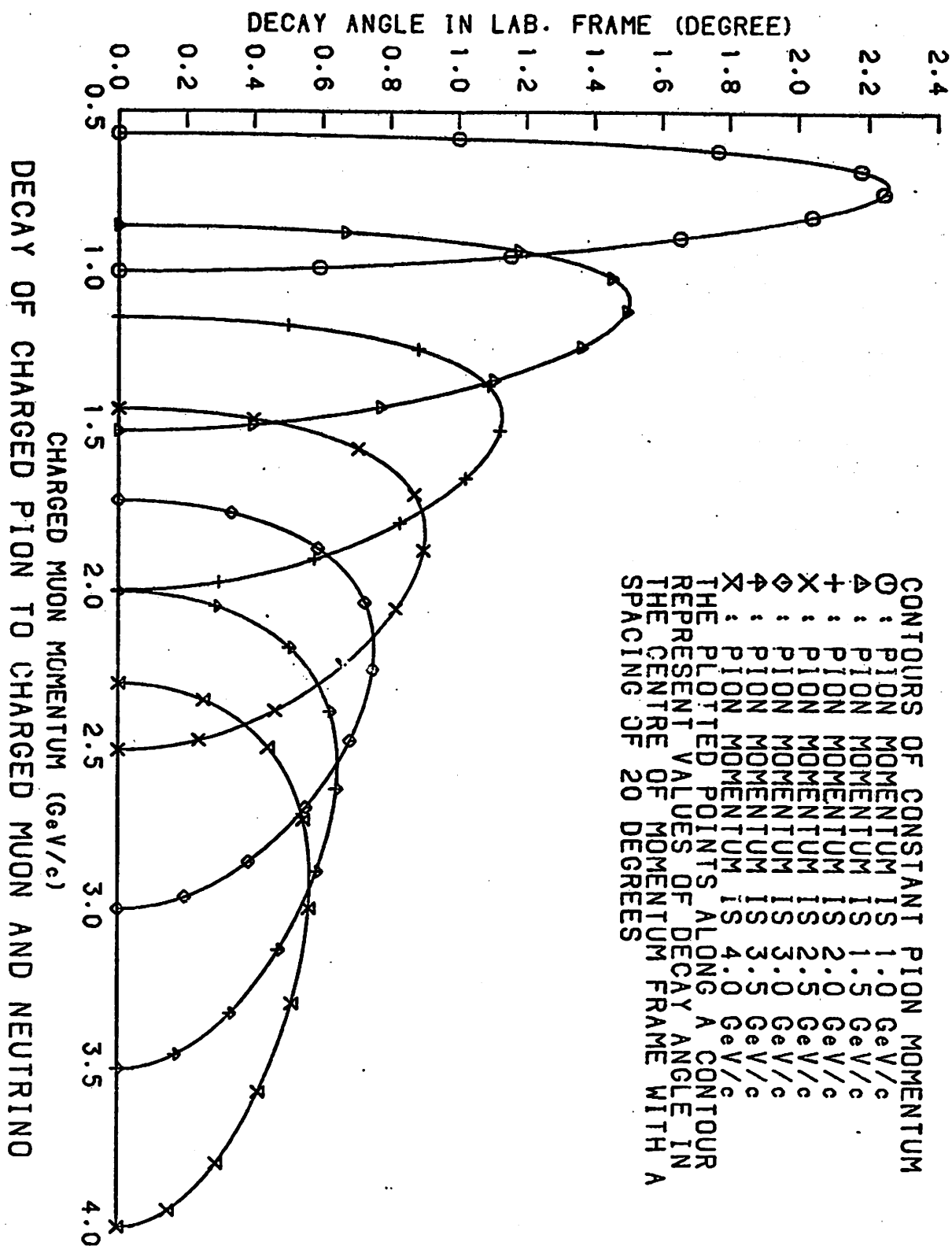


Fig. 7.3

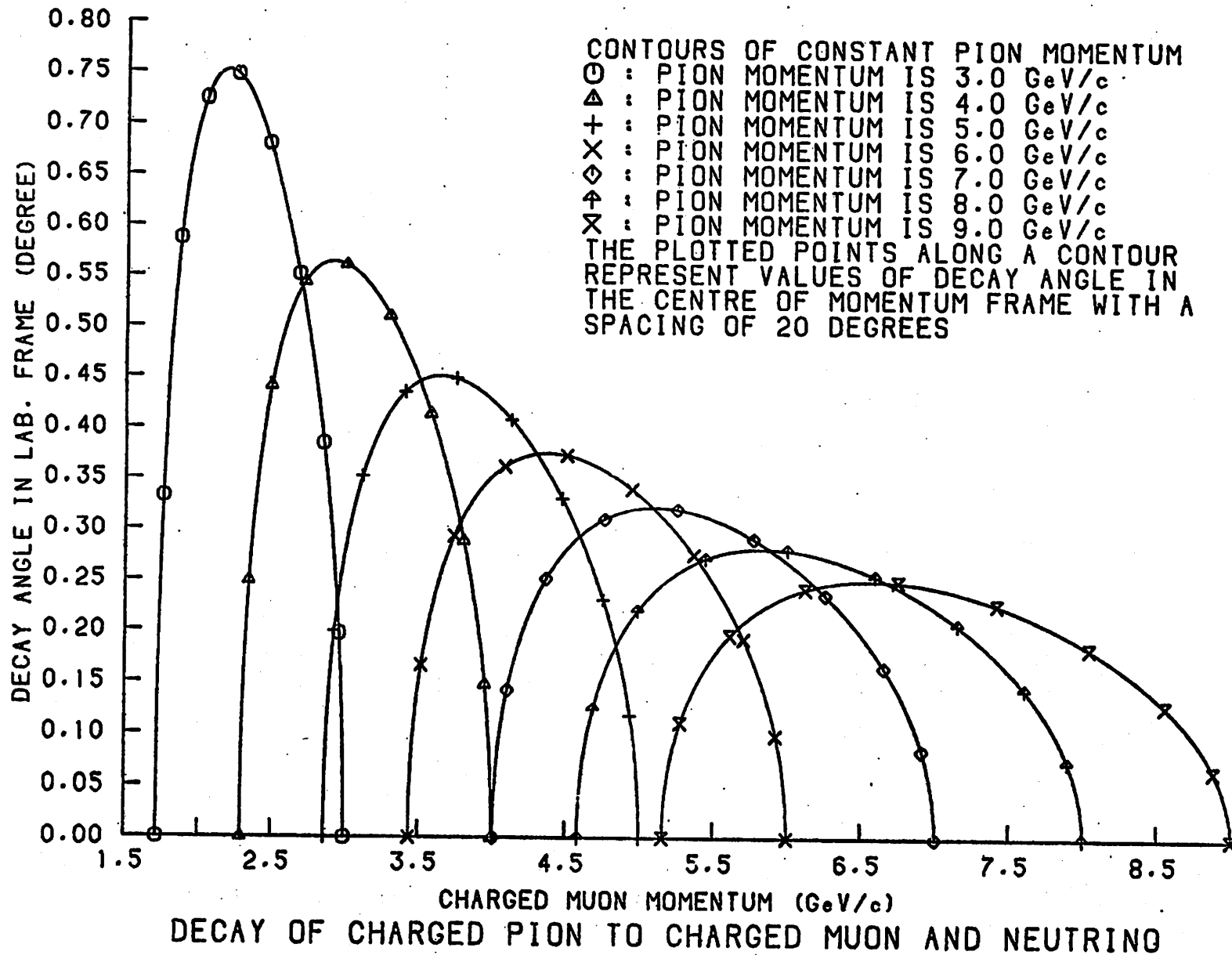
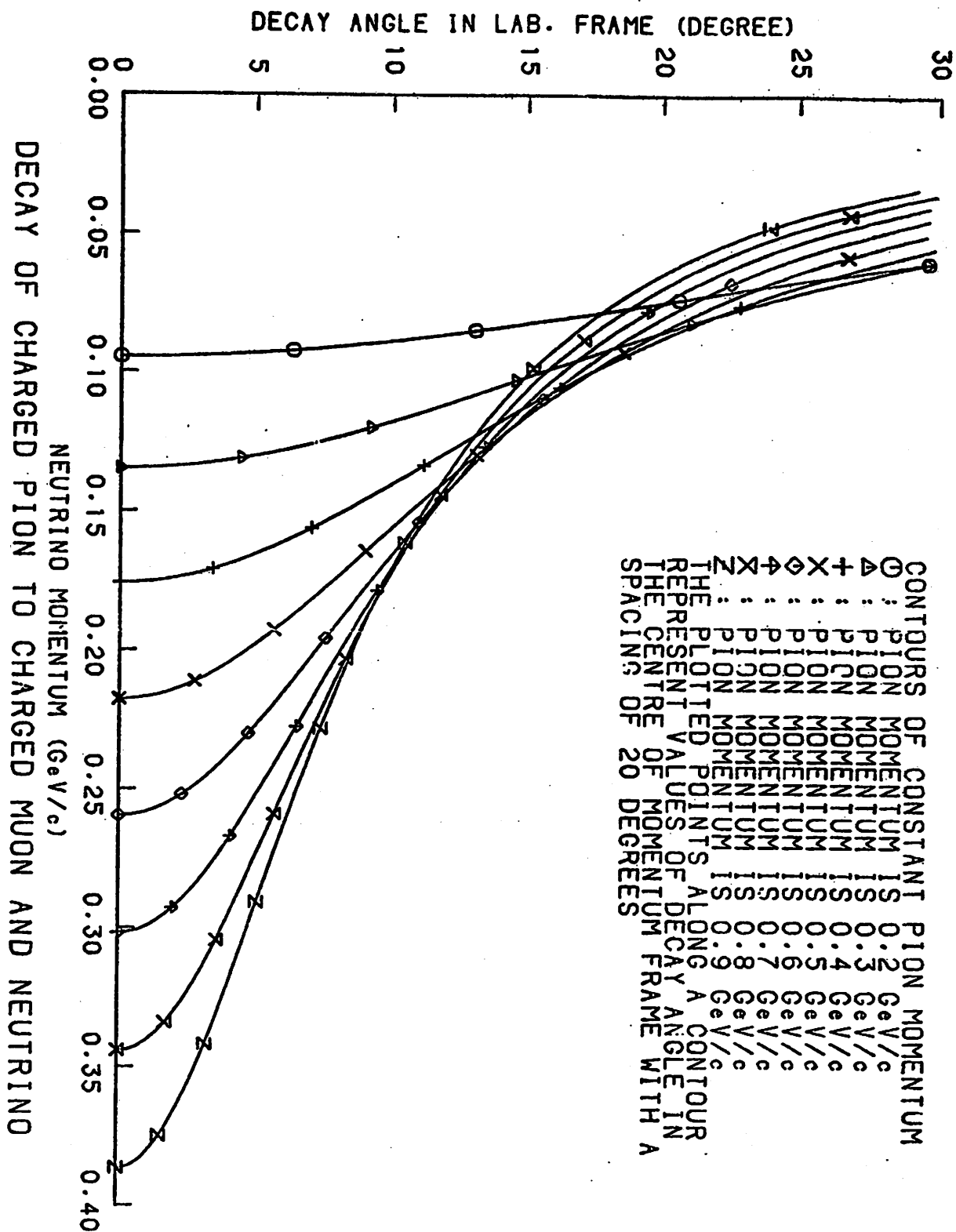


Fig. 7.4



Sanford-Wang Results for 12, 18 and 24 GeV protons

D.E. Lobb

TRIUMF

Physics Department
University of Victoria

The following tables supplement those presented in VPN-82-4. The tables are presented in the following order.

Primary proton bombarding energy (GeV)	Secondary particle	Table Number	
		$\left. \frac{d^2N}{d\Omega dp} \right _{\theta=0}$ (sr·GeV/c) ⁻¹	$\frac{d^2N}{d\Omega dp} \bigg _{\theta}$ $\frac{d^2N}{d\Omega dp} \bigg _{\theta=0}$
12	p	1	6
	π^+	2	7
	π^-	3	8
	κ^+	4	8
	κ^-	5	10
18	p	11	16
	π^+	12	17
	π^-	13	18
	κ^+	14	19
	κ^-	15	20
24	p	21	26
	π^+	22	27
	π^-	23	28
	κ^+	24	29
	κ^-	25	30

REFERENCES

D.E. Lobb and A.K.C. Chan, A Compilation of Data of Interest at >10 GeV
Proton Accelerators, VPN-82-4 (1982)

Table 1

Kinetic energy of the incident proton is 12.00 GEV

Momentum of secondary antiproton <GeV/c>	Zero Degree Production (sr/GeV/c) ⁻¹	
	Sanford-Wang's formula with kinematic reflection	Yamamoto's formula
0.30	0.412886E-07	0.212922E-07
0.35	0.123524E-06	0.824259E-07
0.40	0.323576E-06	0.255013E-06
0.45	0.758312E-06	0.664890E-06
0.50	0.161637E-05	0.151537E-05
0.55	0.317487E-05	0.309886E-05
0.60	0.580870E-05	0.579815E-05
0.65	0.998909E-05	0.100752E-04
0.70	0.162691E-04	0.164491E-04
0.75	0.252606E-04	0.254674E-04
0.80	0.376003E-04	0.376739E-04
0.85	0.539186E-04	0.535768E-04
0.90	0.748038E-04	0.736211E-04
0.95	0.100776E-03	0.981683E-04
1.00	0.102262E-03	0.127478E-03
1.25	0.379771E-03	0.347062E-03
1.50	0.770052E-03	0.667483E-03
1.75	0.126381E-02	0.103420E-02
2.00	0.181334E-02	0.138805E-02
2.25	0.238044E-02	0.168450E-02
2.50	0.268417E-02	0.189879E-02
2.75	0.267494E-02	0.202311E-02
3.00	0.259260E-02	0.206180E-02
3.25	0.245099E-02	0.202654E-02
3.50	0.226534E-02	0.193250E-02
3.75	0.205073E-02	0.179547E-02
4.00	0.182103E-02	0.163042E-02
4.50	0.136176E-02	0.126630E-02
5.00	0.954586E-03	0.916385E-03
5.50	0.630747E-03	0.621635E-03
6.00	0.394421E-03	0.396040E-03
6.50	0.234100E-03	0.236697E-03
7.00	0.132152E-03	0.132181E-03
7.50	0.710476E-04	0.685045E-04
8.00	0.364004E-04	0.326155E-04
8.50	0.177696E-04	0.140584E-04
9.00	0.825698E-05	0.537355E-05
9.50	0.364378E-05	0.176762E-05
10.00	0.152077E-05	0.478339E-06

Table 2

Kinetic energy of the incident proton is 12.00 GEV

Momentum of secondary positive pion <GeV/c>	Zero Degree Production (sr, GeV/c) ⁻¹	
	Sanford-Wang's formula with kinematic reflection	Yamamoto's formula
0.30	0.409016E+00	0.254827E+00
0.35	0.528866E+00	0.305386E+00
0.40	0.577856E+00	0.354182E+00
0.45	0.619303E+00	0.401196E+00
0.50	0.658277E+00	0.446462E+00
0.55	0.695032E+00	0.490026E+00
0.60	0.729768E+00	0.531938E+00
0.65	0.762650E+00	0.572250E+00
0.70	0.793813E+00	0.611008E+00
0.75	0.823370E+00	0.648254E+00
0.80	0.851420E+00	0.684032E+00
0.85	0.878045E+00	0.718378E+00
0.90	0.903319E+00	0.751328E+00
0.95	0.927309E+00	0.782918E+00
1.00	0.950071E+00	0.813184E+00
1.25	0.104714E+01	0.945622E+00
1.50	0.111974E+01	0.104917E+01
1.75	0.117147E+01	0.112698E+01
2.00	0.120514E+01	0.118191E+01
2.25	0.122306E+01	0.121661E+01
2.50	0.122729E+01	0.123353E+01
2.75	0.121963E+01	0.123493E+01
3.00	0.120175E+01	0.122293E+01
3.25	0.117517E+01	0.119946E+01
3.50	0.114127E+01	0.116631E+01
3.75	0.110136E+01	0.112514E+01
4.00	0.105661E+01	0.107747E+01
4.50	0.956763E+00	0.967996E+00
5.00	0.849172E+00	0.847510E+00
5.50	0.739765E+00	0.723700E+00
6.00	0.633097E+00	0.602659E+00
6.50	0.532488E+00	0.488944E+00
7.00	0.440176E+00	0.385771E+00
7.50	0.357495E+00	0.295190E+00
8.00	0.285033E+00	0.218220E+00
8.50	0.222805E+00	0.155031E+00
9.00	0.170393E+00	0.105070E+00
9.50	0.127086E+00	0.672457E-01
10.00	0.919850E-01	0.400492E-01

Table 3

Kinetic energy of the incident proton is 12.00 GeV

Momentum of secondary negative pion <GeV/c>	Zero Degree Production (sr·GeV/c) ⁻¹	
	Sanford-Wang's formula with kinematic reflection	Yamamoto's formula
0.30	0.341548E+00	0.222166E+00
0.35	0.449651E+00	0.266510E+00
0.40	0.484494E+00	0.308904E+00
0.45	0.511963E+00	0.349301E+00
0.50	0.537317E+00	0.387718E+00
0.55	0.560802E+00	0.424200E+00
0.60	0.582612E+00	0.458804E+00
0.65	0.602903E+00	0.491589E+00
0.70	0.621802E+00	0.522614E+00
0.75	0.639415E+00	0.551936E+00
0.80	0.655832E+00	0.579615E+00
0.85	0.671130E+00	0.605701E+00
0.90	0.685377E+00	0.630247E+00
0.95	0.698630E+00	0.653306E+00
1.00	0.710942E+00	0.674923E+00
1.25	0.759875E+00	0.763004E+00
1.50	0.790782E+00	0.821583E+00
1.75	0.806797E+00	0.855381E+00
2.00	0.810331E+00	0.868547E+00
2.25	0.803384E+00	0.864745E+00
2.50	0.787685E+00	0.847229E+00
2.75	0.764773E+00	0.818843E+00
3.00	0.736027E+00	0.782083E+00
3.25	0.702691E+00	0.739115E+00
3.50	0.665891E+00	0.691798E+00
3.75	0.626631E+00	0.641750E+00
4.00	0.585806E+00	0.590318E+00
4.50	0.502503E+00	0.487652E+00
5.00	0.421054E+00	0.390641E+00
5.50	0.345029E+00	0.303509E+00
6.00	0.276689E+00	0.228531E+00
6.50	0.217211E+00	0.166458E+00
7.00	0.166917E+00	0.116946E+00
7.50	0.125508E+00	0.789299E-01
8.00	0.922646E-01	0.508927E-01
8.50	0.662209E-01	0.311168E-01
9.00	0.463062E-01	0.178567E-01
9.50	0.314471E-01	0.948333E-02
10.00	0.206382E-01	0.456728E-02

Table 4

Kinetic energy of the incident proton is 12.00 GEV

Momentum of secondary positive kaon <GeV/c>	Zero Degree Production (sr·GeV/c) ⁻¹	
	Sanford-Wang's formula with kinematic reflection	Yamamoto's formula
0.30	0.396253E-02	0.363430E-02
0.35	0.553709E-02	0.524287E-02
0.40	0.733509E-02	0.711562E-02
0.45	0.933297E-02	0.921229E-02
0.50	0.115096E-01	0.114906E-01
0.55	0.138470E-01	0.139103E-01
0.60	0.163305E-01	0.164347E-01
0.65	0.189483E-01	0.190318E-01
0.70	0.216910E-01	0.216746E-01
0.75	0.245516E-01	0.243402E-01
0.80	0.275249E-01	0.270099E-01
0.85	0.305070E-01	0.296683E-01
0.90	0.337954E-01	0.323029E-01
0.95	0.370986E-01	0.349035E-01
1.00	0.404859E-01	0.374623E-01
1.25	0.589699E-01	0.494404E-01
1.50	0.654407E-01	0.598183E-01
1.75	0.711696E-01	0.685042E-01
2.00	0.762399E-01	0.755427E-01
2.25	0.807058E-01	0.810346E-01
2.50	0.846016E-01	0.851021E-01
2.75	0.879470E-01	0.878719E-01
3.00	0.907502E-01	0.894721E-01
3.25	0.930102E-01	0.900269E-01
3.50	0.947196E-01	0.896560E-01
3.75	0.958652E-01	0.884712E-01
4.00	0.964309E-01	0.865826E-01
4.50	0.957518E-01	0.810875E-01
5.00	0.925614E-01	0.739048E-01
5.50	0.868248E-01	0.656703E-01
6.00	0.786721E-01	0.569232E-01
6.50	0.684665E-01	0.481136E-01
7.00	0.568360E-01	0.396038E-01
7.50	0.446412E-01	0.316754E-01
8.00	0.328650E-01	0.245354E-01
8.50	0.224341E-01	0.183179E-01
9.00	0.140227E-01	0.130916E-01
9.50	0.791004E-02	0.887431E-02
10.00	0.395762E-02	0.562729E-02

Table 5

Kinetic energy of the incident proton is 12.00 GEV

Momentum of secondary negative kaon <GeV/c>	Zero Degree Production (sr·GeV/c) ⁻¹	
	Sanford-Wang's formula with kinematic reflection	Yamamoto's formula
0.30	0.903949E-03	0.892890E-03
0.35	0.143712E-02	0.141888E-02
0.40	0.210802E-02	0.208717E-02
0.45	0.290482E-02	0.289007E-02
0.50	0.381065E-02	0.381342E-02
0.55	0.480682E-02	0.483930E-02
0.60	0.587502E-02	0.594815E-02
0.65	0.699886E-02	0.712050E-02
0.70	0.816419E-02	0.833782E-02
0.75	0.935937E-02	0.958315E-02
0.80	0.105752E-01	0.108416E-01
0.85	0.118044E-01	0.121001E-01
0.90	0.130416E-01	0.133475E-01
0.95	0.142826E-01	0.145745E-01
1.00	0.155248E-01	0.157733E-01
1.25	0.216901E-01	0.211602E-01
1.50	0.249955E-01	0.253001E-01
1.75	0.274666E-01	0.281371E-01
2.00	0.290806E-01	0.297793E-01
2.25	0.298676E-01	0.303981E-01
2.50	0.298971E-01	0.301801E-01
2.75	0.292653E-01	0.293032E-01
3.00	0.280844E-01	0.279295E-01
3.25	0.264733E-01	0.262006E-01
3.50	0.245493E-01	0.242374E-01
3.75	0.224225E-01	0.221394E-01
4.00	0.201918E-01	0.199898E-01
4.50	0.157411E-01	0.157794E-01
5.00	0.116894E-01	0.119626E-01
5.50	0.829814E-02	0.871965E-02
6.00	0.564537E-02	0.610727E-02
6.50	0.368707E-02	0.410198E-02
7.00	0.231436E-02	0.263279E-02
7.50	0.139693E-02	0.160657E-02
8.00	0.810787E-03	0.925583E-03
8.50	0.452195E-03	0.498601E-03
9.00	0.241978E-03	0.247744E-03
9.50	0.123908E-03	0.111504E-03
10.00	0.604417E-04	0.442526E-04

Table 6

Kinetic energy of the incident proton beam is 12.00 GeV

Momentum	Sanford-Wang's Angular Dependence							
of	with							
secondary	-----							
antiproton	production angle in laboratory frame							
<GeV/c>	0	1	2	4	8	16	24	32

0.30	1.000	0.982	0.962	0.918	0.813	0.573	0.350	0.185
0.35	1.000	0.980	0.957	0.908	0.792	0.534	0.307	0.150
0.40	1.000	0.977	0.953	0.898	0.772	0.500	0.271	0.122
0.45	1.000	0.975	0.948	0.888	0.753	0.469	0.241	0.101
0.50	1.000	0.973	0.944	0.880	0.737	0.443	0.215	0.084
0.55	1.000	0.971	0.940	0.872	0.721	0.418	0.193	0.070
0.60	1.000	0.969	0.937	0.865	0.707	0.397	0.174	0.059
0.65	1.000	0.968	0.933	0.858	0.695	0.378	0.157	0.049
0.70	1.000	0.966	0.930	0.853	0.683	0.360	0.143	0.042
0.75	1.000	0.965	0.928	0.847	0.673	0.344	0.130	0.035
0.80	1.000	0.964	0.925	0.843	0.664	0.330	0.118	0.030
0.85	1.000	0.963	0.923	0.839	0.655	0.316	0.108	0.025
0.90	1.000	0.962	0.922	0.835	0.648	0.303	0.098	0.022
0.95	1.000	0.961	0.920	0.832	0.641	0.292	0.090	0.018
1.00	1.000	0.961	0.919	0.830	0.635	0.280	0.082	0.015
1.25	1.000	0.961	0.919	0.825	0.613	0.229	0.050	0.006
1.50	1.000	0.965	0.926	0.832	0.596	0.179	0.029	0.002
1.75	1.000	0.973	0.940	0.848	0.574	0.131	0.016	0.001
2.00	1.000	0.986	0.962	0.868	0.535	0.090	0.008	0.000
2.25	1.000	1.004	0.991	0.887	0.476	0.059	0.004	0.000
2.50	1.000	1.007	0.999	0.900	0.437	0.041	0.002	0.000
2.75	1.000	0.987	0.961	0.833	0.385	0.031	0.001	0.000
3.00	1.000	0.968	0.924	0.770	0.330	0.024	0.001	0.000
3.25	1.000	0.949	0.889	0.712	0.282	0.018	0.000	0.000
3.50	1.000	0.931	0.855	0.659	0.242	0.014	0.000	0.000
3.75	1.000	0.913	0.822	0.610	0.207	0.011	0.000	0.000
4.00	1.000	0.896	0.791	0.564	0.177	0.008	0.000	0.000
4.50	1.000	0.861	0.732	0.483	0.130	0.004	0.000	0.000
5.00	1.000	0.828	0.677	0.413	0.095	0.002	0.000	0.000
5.50	1.000	0.797	0.626	0.354	0.070	0.001	0.000	0.000
6.00	1.000	0.766	0.579	0.303	0.051	0.001	0.000	0.000
6.50	1.000	0.737	0.536	0.259	0.037	0.000	0.000	0.000
7.00	1.000	0.709	0.496	0.222	0.027	0.000	0.000	0.000
7.50	1.000	0.682	0.459	0.190	0.020	0.000	0.000	0.000
8.00	1.000	0.656	0.424	0.162	0.015	0.000	0.000	0.000
8.50	1.000	0.631	0.392	0.139	0.011	0.000	0.000	0.000
9.00	1.000	0.607	0.363	0.119	0.008	0.000	0.000	0.000
9.50	1.000	0.584	0.336	0.102	0.006	0.000	0.000	0.000
10.00	1.000	0.561	0.311	0.087	0.004	0.000	0.000	0.000

Note : All angles are in degree

Table 7

Kinetic energy of the incident proton beam is 12.00 GeV

Momentum Sanford-Wang's Angular Dependence
of with
secondary kinematic reflection

+ pion production angle in laboratory frame

<GeV/c>	0	1	2	4	8	16	24	32
0.30	1.000	1.120	1.243	1.463	1.591	1.103	0.739	0.534
0.35	1.000	1.170	1.345	1.610	1.528	0.847	0.545	0.389
0.40	1.000	1.171	1.351	1.644	1.514	0.728	0.463	0.327
0.45	1.000	1.165	1.339	1.616	1.461	0.635	0.399	0.277
0.50	1.000	1.160	1.327	1.588	1.411	0.567	0.348	0.235
0.55	1.000	1.155	1.316	1.560	1.362	0.520	0.306	0.200
0.60	1.000	1.150	1.304	1.533	1.315	0.485	0.271	0.171
0.65	1.000	1.145	1.293	1.506	1.270	0.452	0.241	0.146
0.70	1.000	1.140	1.282	1.480	1.226	0.422	0.215	0.125
0.75	1.000	1.135	1.270	1.454	1.184	0.393	0.193	0.107
0.80	1.000	1.130	1.259	1.429	1.143	0.366	0.173	0.092
0.85	1.000	1.125	1.248	1.404	1.103	0.341	0.155	0.079
0.90	1.000	1.120	1.237	1.380	1.065	0.318	0.139	0.067
0.95	1.000	1.115	1.226	1.356	1.029	0.297	0.125	0.058
1.00	1.000	1.111	1.216	1.332	0.993	0.277	0.112	0.050
1.25	1.000	1.086	1.164	1.220	0.833	0.195	0.066	0.023
1.50	1.000	1.063	1.114	1.118	0.699	0.137	0.038	0.011
1.75	1.000	1.040	1.066	1.024	0.587	0.096	0.022	0.005
2.00	1.000	1.017	1.020	0.938	0.492	0.068	0.013	0.002
2.25	1.000	0.995	0.976	0.859	0.413	0.048	0.008	0.001
2.50	1.000	0.974	0.934	0.787	0.346	0.034	0.004	0.000
2.75	1.000	0.952	0.894	0.721	0.291	0.024	0.003	0.000
3.00	1.000	0.932	0.856	0.660	0.244	0.017	0.001	0.000
3.25	1.000	0.912	0.819	0.605	0.205	0.012	0.001	0.000
3.50	1.000	0.892	0.784	0.554	0.172	0.008	0.000	0.000
3.75	1.000	0.872	0.750	0.507	0.144	0.006	0.000	0.000
4.00	1.000	0.853	0.718	0.465	0.121	0.004	0.000	0.000
4.50	1.000	0.817	0.658	0.390	0.085	0.002	0.000	0.000
5.00	1.000	0.782	0.602	0.327	0.060	0.001	0.000	0.000
5.50	1.000	0.748	0.552	0.274	0.042	0.000	0.000	0.000
6.00	1.000	0.716	0.505	0.230	0.030	0.000	0.000	0.000
6.50	1.000	0.685	0.463	0.193	0.021	0.000	0.000	0.000
7.00	1.000	0.656	0.424	0.162	0.015	0.000	0.000	0.000
7.50	1.000	0.628	0.388	0.136	0.010	0.000	0.000	0.000
8.00	1.000	0.601	0.356	0.114	0.007	0.000	0.000	0.000
8.50	1.000	0.575	0.326	0.096	0.005	0.000	0.000	0.000
9.00	1.000	0.550	0.298	0.080	0.004	0.000	0.000	0.000
9.50	1.000	0.527	0.273	0.067	0.003	0.000	0.000	0.000
10.00	1.000	0.504	0.250	0.057	0.002	0.000	0.000	0.000

Note : All angles are in degree

Table 8

Kinetic energy of the incident proton beam is 12.00 GeV

Momentum		Sanford-Wang's Angular Dependence						
of		with						
secondary		kinematic reflection						

- pion	production angle in laboratory frame							
<GeV/c>	0	1	2	4	8	16	24	32

0.30	1.000	1.135	1.275	1.525	1.659	1.099	0.711	0.502
0.35	1.000	1.191	1.389	1.687	1.569	0.820	0.511	0.356
0.40	1.000	1.192	1.398	1.732	1.562	0.712	0.438	0.302
0.45	1.000	1.187	1.386	1.704	1.511	0.632	0.383	0.258
0.50	1.000	1.182	1.375	1.676	1.462	0.575	0.338	0.221
0.55	1.000	1.177	1.363	1.648	1.415	0.535	0.301	0.189
0.60	1.000	1.173	1.352	1.621	1.369	0.501	0.270	0.163
0.65	1.000	1.168	1.341	1.595	1.324	0.469	0.243	0.140
0.70	1.000	1.163	1.330	1.569	1.281	0.439	0.219	0.121
0.75	1.000	1.158	1.319	1.543	1.240	0.411	0.198	0.104
0.80	1.000	1.153	1.308	1.518	1.199	0.384	0.179	0.090
0.85	1.000	1.149	1.297	1.493	1.160	0.360	0.162	0.078
0.90	1.000	1.144	1.287	1.468	1.123	0.337	0.146	0.067
0.95	1.000	1.139	1.276	1.444	1.086	0.315	0.132	0.058
1.00	1.000	1.134	1.266	1.421	1.051	0.295	0.120	0.050
1.25	1.000	1.111	1.214	1.308	0.891	0.212	0.073	0.024
1.50	1.000	1.088	1.165	1.204	0.755	0.152	0.044	0.011
1.75	1.000	1.066	1.118	1.109	0.640	0.109	0.026	0.005
2.00	1.000	1.044	1.073	1.021	0.542	0.079	0.016	0.002
2.25	1.000	1.023	1.029	0.940	0.460	0.057	0.009	0.001
2.50	1.000	1.002	0.988	0.865	0.390	0.041	0.006	0.000
2.75	1.000	0.982	0.948	0.797	0.330	0.029	0.003	0.000
3.00	1.000	0.962	0.909	0.733	0.280	0.021	0.002	0.000
3.25	1.000	0.942	0.873	0.675	0.237	0.015	0.001	0.000
3.50	1.000	0.923	0.837	0.622	0.201	0.011	0.001	0.000
3.75	1.000	0.904	0.803	0.572	0.171	0.008	0.000	0.000
4.00	1.000	0.885	0.771	0.527	0.145	0.006	0.000	0.000
4.50	1.000	0.849	0.710	0.447	0.104	0.003	0.000	0.000
5.00	1.000	0.815	0.653	0.379	0.075	0.001	0.000	0.000
5.50	1.000	0.782	0.602	0.321	0.054	0.001	0.000	0.000
6.00	1.000	0.750	0.554	0.272	0.039	0.000	0.000	0.000
6.50	1.000	0.720	0.510	0.231	0.028	0.000	0.000	0.000
7.00	1.000	0.691	0.469	0.195	0.020	0.000	0.000	0.000
7.50	1.000	0.663	0.432	0.166	0.014	0.000	0.000	0.000
8.00	1.000	0.636	0.398	0.140	0.010	0.000	0.000	0.000
8.50	1.000	0.610	0.366	0.119	0.007	0.000	0.000	0.000
9.00	1.000	0.586	0.337	0.101	0.005	0.000	0.000	0.000
9.50	1.000	0.562	0.311	0.086	0.004	0.000	0.000	0.000
10.00	1.000	0.539	0.286	0.073	0.003	0.000	0.000	0.000

Note : All angles are in degree

Table 9

Kinetic energy of the incident proton beam is 12.00 GeV

Momentum of secondary	Sanford-Wang's Angular Dependence with kinematic reflection							
	production angle in laboratory frame							
<GeV/c>	0	1	2	4	8	16	24	32
0.30	1.000	0.991	0.982	0.962	0.920	0.824	0.713	0.597
0.35	1.000	0.991	0.982	0.963	0.920	0.815	0.690	0.560
0.40	1.000	0.992	0.983	0.965	0.923	0.810	0.669	0.523
0.45	1.000	0.993	0.986	0.970	0.929	0.807	0.648	0.487
0.50	1.000	0.995	0.990	0.977	0.938	0.806	0.626	0.449
0.55	1.000	0.998	0.995	0.986	0.951	0.805	0.601	0.410
0.60	1.000	1.001	1.001	0.997	0.967	0.802	0.572	0.371
0.65	1.000	1.005	1.009	1.011	0.985	0.797	0.540	0.333
0.70	1.000	1.010	1.018	1.027	1.005	0.788	0.505	0.295
0.75	1.000	1.015	1.028	1.045	1.026	0.774	0.467	0.259
0.80	1.000	1.021	1.039	1.066	1.048	0.753	0.427	0.225
0.85	1.000	1.027	1.052	1.089	1.070	0.727	0.387	0.194
0.90	1.000	1.035	1.067	1.114	1.091	0.694	0.347	0.166
0.95	1.000	1.043	1.083	1.141	1.109	0.655	0.308	0.141
1.00	1.000	1.052	1.100	1.170	1.123	0.613	0.271	0.120
1.25	1.000	1.110	1.213	1.334	1.099	0.379	0.133	0.050
1.50	1.000	1.086	1.169	1.270	1.012	0.247	0.076	0.025
1.75	1.000	1.063	1.119	1.165	0.852	0.154	0.042	0.012
2.00	1.000	1.040	1.072	1.069	0.717	0.102	0.023	0.006
2.25	1.000	1.018	1.027	0.981	0.604	0.072	0.013	0.003
2.50	1.000	0.997	0.984	0.900	0.508	0.051	0.008	0.001
2.75	1.000	0.975	0.942	0.826	0.428	0.036	0.004	0.001
3.00	1.000	0.955	0.903	0.758	0.360	0.026	0.003	0.000
3.25	1.000	0.934	0.865	0.695	0.303	0.018	0.001	0.000
3.50	1.000	0.915	0.828	0.638	0.255	0.013	0.001	0.000
3.75	1.000	0.895	0.793	0.585	0.215	0.009	0.000	0.000
4.00	1.000	0.876	0.760	0.537	0.181	0.006	0.000	0.000
4.50	1.000	0.839	0.697	0.452	0.128	0.003	0.000	0.000
5.00	1.000	0.804	0.640	0.381	0.091	0.002	0.000	0.000
5.50	1.000	0.770	0.587	0.321	0.065	0.001	0.000	0.000
6.00	1.000	0.738	0.539	0.270	0.046	0.000	0.000	0.000
6.50	1.000	0.707	0.494	0.227	0.032	0.000	0.000	0.000
7.00	1.000	0.677	0.454	0.191	0.023	0.000	0.000	0.000
7.50	1.000	0.648	0.416	0.161	0.016	0.000	0.000	0.000
8.00	1.000	0.621	0.382	0.136	0.012	0.000	0.000	0.000
8.50	1.000	0.595	0.350	0.114	0.008	0.000	0.000	0.000
9.00	1.000	0.570	0.322	0.096	0.006	0.000	0.000	0.000
9.50	1.000	0.546	0.295	0.081	0.004	0.000	0.000	0.000
10.00	1.000	0.523	0.271	0.068	0.003	0.000	0.000	0.000

Note : All angles are in degree

Table 10

Kinetic energy of the incident proton beam is 12.00 GeV

Momentum

Sanford-Wang's Angular Dependence

with

of

kinematic reflection

secondary

- kaon

production angle in laboratory frame

<GeV/c>	0	1	2	4	8	16	24	32
0.30	1.000	0.989	0.978	0.952	0.893	0.750	0.587	0.427
0.35	1.000	0.989	0.977	0.950	0.888	0.732	0.555	0.385
0.40	1.000	0.989	0.977	0.950	0.886	0.718	0.526	0.347
0.45	1.000	0.990	0.978	0.952	0.887	0.707	0.499	0.312
0.50	1.000	0.991	0.980	0.956	0.890	0.697	0.471	0.278
0.55	1.000	0.992	0.984	0.961	0.896	0.687	0.443	0.247
0.60	1.000	0.995	0.988	0.969	0.904	0.675	0.414	0.217
0.65	1.000	0.997	0.993	0.978	0.913	0.661	0.383	0.189
0.70	1.000	1.001	0.999	0.989	0.923	0.643	0.352	0.163
0.75	1.000	1.004	1.007	1.001	0.933	0.620	0.319	0.139
0.80	1.000	1.009	1.015	1.015	0.943	0.594	0.288	0.118
0.85	1.000	1.014	1.025	1.030	0.950	0.563	0.257	0.100
0.90	1.000	1.019	1.035	1.047	0.956	0.529	0.227	0.084
0.95	1.000	1.025	1.047	1.065	0.957	0.492	0.200	0.070
1.00	1.000	1.032	1.060	1.083	0.954	0.454	0.175	0.058
1.25	1.000	1.076	1.140	1.172	0.852	0.275	0.096	0.023
1.50	1.000	1.054	1.098	1.104	0.732	0.177	0.047	0.009
1.75	1.000	1.033	1.055	1.017	0.622	0.118	0.026	0.004
2.00	1.000	1.012	1.012	0.937	0.528	0.084	0.015	0.001
2.25	1.000	0.992	0.972	0.864	0.449	0.061	0.008	0.001
2.50	1.000	0.972	0.933	0.796	0.381	0.044	0.005	0.000
2.75	1.000	0.952	0.896	0.734	0.324	0.032	0.003	0.000
3.00	1.000	0.933	0.860	0.676	0.275	0.023	0.002	0.000
3.25	1.000	0.914	0.826	0.624	0.234	0.016	0.001	0.000
3.50	1.000	0.896	0.793	0.575	0.199	0.012	0.001	0.000
3.75	1.000	0.878	0.761	0.530	0.169	0.009	0.000	0.000
4.00	1.000	0.860	0.731	0.488	0.143	0.006	0.000	0.000
4.50	1.000	0.826	0.673	0.415	0.103	0.003	0.000	0.000
5.00	1.000	0.793	0.621	0.352	0.075	0.002	0.000	0.000
5.50	1.000	0.761	0.572	0.299	0.054	0.001	0.000	0.000
6.00	1.000	0.731	0.527	0.254	0.039	0.000	0.000	0.000
6.50	1.000	0.701	0.486	0.216	0.028	0.000	0.000	0.000
7.00	1.000	0.673	0.448	0.183	0.020	0.000	0.000	0.000
7.50	1.000	0.646	0.413	0.156	0.015	0.000	0.000	0.000
8.00	1.000	0.621	0.380	0.132	0.011	0.000	0.000	0.000
8.50	1.000	0.596	0.351	0.112	0.008	0.000	0.000	0.000
9.00	1.000	0.572	0.323	0.096	0.005	0.000	0.000	0.000
9.50	1.000	0.549	0.298	0.081	0.004	0.000	0.000	0.000
10.00	1.000	0.527	0.275	0.069	0.003	0.000	0.000	0.000

Note : All angles are in degree

Table 11

Kinetic energy of the incident proton is 18.00 GEV

Momentum cf secondary antiproton <GeV/c>	Zero Degree Production (sr·GeV/c) ⁻¹	
	Sanford-Wang's formula with kinematic reflection	Yamamoto's formula
0.30	0.300576E-07	0.270815E-07
0.35	0.949149E-07	0.105652E-06
0.40	0.261060E-06	0.329505E-06
0.45	0.639346E-06	0.866290E-06
0.50	0.141802E-05	0.199140E-05
0.55	0.288693E-05	0.410852E-05
0.60	0.545578E-05	0.775754E-05
0.65	0.966068E-05	0.136064E-04
0.70	0.161560E-04	0.224278E-04
0.75	0.256925E-04	0.350655E-04
0.80	0.390821E-04	0.523935E-04
0.85	0.571579E-04	0.752736E-04
0.90	0.807285E-04	0.104515E-03
0.95	0.110540E-03	0.140846E-03
1.00	0.147241E-03	0.184878E-03
1.25	0.447505E-03	0.532489E-03
1.50	0.941433E-03	0.108751E-02
1.75	0.158319E-02	0.179544E-02
2.00	0.230888E-02	0.257618E-02
2.25	0.306380E-02	0.335302E-02
2.50	0.381062E-02	0.406669E-02
2.75	0.452720E-02	0.467752E-02
3.00	0.504605E-02	0.516389E-02
3.25	0.522982E-02	0.551794E-02
3.50	0.532452E-02	0.574191E-02
3.75	0.533460E-02	0.584488E-02
4.00	0.526709E-02	0.583963E-02
4.50	0.493658E-02	0.556666E-02
5.00	0.441620E-02	0.504735E-02
5.50	0.379103E-02	0.439327E-02
6.00	0.313539E-02	0.369272E-02
6.50	0.250608E-02	0.300880E-02
7.00	0.194052E-02	0.238218E-02
7.50	0.145849E-02	0.183520E-02
8.00	0.106568E-02	0.137653E-02
8.50	0.757943E-03	0.100524E-02
9.00	0.525262E-03	0.714320E-03
9.50	0.354981E-03	0.493390E-03
10.00	0.234097E-03	0.330704E-03

Table 12

Kinetic energy of the incident proton is 18.00 GEV

Momentum of secondary positive pion <GeV/c>	Zero Degree Production (sr·GeV/c) ⁻¹	
	Sanford-Wang's formula with kinematic reflection	Yamamoto's formula
0.30	0.345151E+00	0.262644E+00
0.35	0.441271E+00	0.316329E+00
0.40	0.544935E+00	0.368720E+00
0.45	0.631134E+00	0.419780E+00
0.50	0.672675E+00	0.469522E+00
0.55	0.712233E+00	0.517980E+00
0.60	0.750008E+00	0.565186E+00
0.65	0.786159E+00	0.611177E+00
0.70	0.820818E+00	0.655985E+00
0.75	0.854094E+00	0.699637E+00
0.80	0.886083E+00	0.742163E+00
0.85	0.916863E+00	0.783587E+00
0.90	0.946503E+00	0.823928E+00
0.95	0.975067E+00	0.863215E+00
1.00	0.100261E+01	0.901468E+00
1.25	0.112644E+01	0.107774E+01
1.50	0.123016E+01	0.123054E+01
1.75	0.131671E+01	0.136164E+01
2.00	0.138818E+01	0.147266E+01
2.25	0.144620E+01	0.156506E+01
2.50	0.149209E+01	0.164026E+01
2.75	0.152699E+01	0.169959E+01
3.00	0.155188E+01	0.174434E+01
3.25	0.156765E+01	0.177569E+01
3.50	0.157513E+01	0.179475E+01
3.75	0.157506E+01	0.180268E+01
4.00	0.156816E+01	0.180045E+01
4.50	0.153645E+01	0.176947E+01
5.00	0.148487E+01	0.170913E+01
5.50	0.141776E+01	0.162584E+01
6.00	0.133898E+01	0.152542E+01
6.50	0.125196E+01	0.141294E+01
7.00	0.115968E+01	0.129283E+01
7.50	0.106471E+01	0.116890E+01
8.00	0.969241E+00	0.104442E+01
8.50	0.875083E+00	0.922140E+00
9.00	0.783710E+00	0.804273E+00
9.50	0.696281E+00	0.692626E+00
10.00	0.613671E+00	0.588540E+00

Table 13

Kinetic energy of the incident proton is 18.00 GEV

Momentum	Zero Degree Production	
cf	(sr·GeV/c) ⁻¹	

secondary	Sanford-Wang's	Yamamoto's
negative pion	formula	
<GeV/c>	with	
	kinematic reflection	formula

0.30	0.274750E+00	0.231576E+00
0.35	0.357501E+00	0.279707E+00
0.40	0.448427E+00	0.326444E+00
0.45	0.521648E+00	0.371704E+00
0.50	0.549004E+00	0.415473E+00
0.55	0.574662E+00	0.457772E+00
0.60	0.598814E+00	0.498626E+00
0.65	0.621611E+00	0.538072E+00
0.70	0.643178E+00	0.576142E+00
0.75	0.663618E+00	0.612871E+00
0.80	0.683017E+00	0.648293E+00
0.85	0.701449E+00	0.682438E+00
0.90	0.718976E+00	0.715334E+00
0.95	0.735654E+00	0.747018E+00
1.00	0.751532E+00	0.777518E+00
1.25	0.820247E+00	0.913064E+00
1.50	0.873788E+00	0.102264E+01
1.75	0.914700E+00	0.110902E+01
2.00	0.944780E+00	0.117470E+01
2.25	0.965408E+00	0.122195E+01
2.50	0.977706E+00	0.125289E+01
2.75	0.982626E+00	0.126946E+01
3.00	0.981008E+00	0.127348E+01
3.25	0.973605E+00	0.126656E+01
3.50	0.961105E+00	0.125017E+01
3.75	0.944143E+00	0.122577E+01
4.00	0.923308E+00	0.119456E+01
4.50	0.872170E+00	0.111625E+01
5.00	0.811640E+00	0.102329E+01
5.50	0.745117E+00	0.922071E+00
6.00	0.675493E+00	0.817816E+00
6.50	0.605170E+00	0.714525E+00
7.00	0.536090E+00	0.615231E+00
7.50	0.469773E+00	0.522133E+00
8.00	0.407342E+00	0.436704E+00
8.50	0.349579E+00	0.359853E+00
9.00	0.296962E+00	0.291963E+00
9.50	0.249718E+00	0.233057E+00
10.00	0.207865E+00	0.182835E+00

Table 14

Kinetic energy of the incident proton is 18.00 GEV

Momentum of secondary positive kaon <GeV/c>	Zero Degree Production (sr, GeV/c) ⁻¹	
	Sanford-Wang's formula with kinematic reflection	Yamamoto's formula
0.30	0.348488E-02	0.376806E-02
0.35	0.487212E-02	0.546187E-02
0.40	0.645338E-02	0.744770E-02
0.45	0.820633E-02	0.968700E-02
0.50	0.101109E-01	0.121385E-01
0.55	0.121498E-01	0.147622E-01
0.60	0.143086E-01	0.175214E-01
0.65	0.165757E-01	0.203838E-01
0.70	0.189412E-01	0.233217E-01
0.75	0.213976E-01	0.263114E-01
0.80	0.239386E-01	0.293334E-01
0.85	0.265595E-01	0.323715E-01
0.90	0.292562E-01	0.354123E-01
0.95	0.320258E-01	0.384449E-01
1.00	0.348662E-01	0.414603E-01
1.25	0.500781E-01	0.560623E-01
1.50	0.669376E-01	0.695575E-01
1.75	0.747801E-01	0.817602E-01
2.00	0.808065E-01	0.926309E-01
2.25	0.863454E-01	0.102191E+00
2.50	0.914424E-01	0.110491E+00
2.75	0.961310E-01	0.117592E+00
3.00	0.100436E+00	0.123561E+00
3.25	0.104376E+00	0.128466E+00
3.50	0.107964E+00	0.132375E+00
3.75	0.111207E+00	0.135355E+00
4.00	0.114112E+00	0.137472E+00
4.50	0.118908E+00	0.139366E+00
5.00	0.122335E+00	0.138541E+00
5.50	0.124348E+00	0.135445E+00
6.00	0.124883E+00	0.130491E+00
6.50	0.123873E+00	0.124058E+00
7.00	0.121261E+00	0.116491E+00
7.50	0.117022E+00	0.108098E+00
8.00	0.111172E+00	0.991620E-01
8.50	0.103795E+00	0.899298E-01
9.00	0.950497E-01	0.806088E-01
9.50	0.851818E-01	0.714014E-01
10.00	0.745188E-01	0.624651E-01

Table 15

Kinetic energy of the incident proton is 18.00 GeV

Momentum of secondary negative kaon <GeV/c>	Zero Degree Production (sr·GeV/c) ⁻¹	
	Sanford-Wang's formula with kinematic reflection	Yamamoto's formula
0.30	0.976282E-03	0.957206E-03
0.35	0.155840E-02	0.153513E-02
0.40	0.229301E-02	0.227866E-02
0.45	0.316714E-02	0.318347E-02
0.50	0.416182E-02	0.423793E-02
0.55	0.525586E-02	0.542575E-02
0.60	0.642839E-02	0.672815E-02
0.65	0.766052E-02	0.812582E-02
0.70	0.893588E-02	0.959980E-02
0.75	0.102409E-01	0.111324E-01
0.80	0.115645E-01	0.127075E-01
0.85	0.128985E-01	0.143109E-01
0.90	0.142359E-01	0.159297E-01
0.95	0.155719E-01	0.175532E-01
1.00	0.169029E-01	0.191720E-01
1.25	0.234167E-01	0.269506E-01
1.50	0.296581E-01	0.338211E-01
1.75	0.343845E-01	0.395474E-01
2.00	0.383940E-01	0.440901E-01
2.25	0.417762E-01	0.475019E-01
2.50	0.444973E-01	0.498793E-01
2.75	0.465481E-01	0.513333E-01
3.00	0.479389E-01	0.519814E-01
3.25	0.486969E-01	0.519358E-01
3.50	0.488623E-01	0.513029E-01
3.75	0.484855E-01	0.501814E-01
4.00	0.476242E-01	0.486618E-01
4.50	0.446978E-01	0.447412E-01
5.00	0.405934E-01	0.400862E-01
5.50	0.357979E-01	0.351162E-01
6.00	0.307350E-01	0.301428E-01
6.50	0.257427E-01	0.253863E-01
7.00	0.210668E-01	0.209936E-01
7.50	0.168655E-01	0.170518E-01
8.00	0.132218E-01	0.136034E-01
8.50	0.101579E-01	0.106549E-01
9.00	0.765252E-02	0.818618E-02
9.50	0.565587E-02	0.616520E-02
10.00	0.410230E-02	0.454523E-02

Table 16

Kinetic energy of the incident proton beam is 18.00 GeV

Momentum Sanford-Wang's Angular Dependence
of with
 kinematic reflection

secondary -----

antiproton production angle in laboratory frame

<GeV/c>	0	1	2	4	8	16	24	32
0.30	1.000	0.982	0.962	0.917	0.809	0.562	0.335	0.171
0.35	1.000	0.980	0.957	0.906	0.787	0.523	0.293	0.138
0.40	1.000	0.977	0.952	0.896	0.767	0.488	0.257	0.112
0.45	1.000	0.975	0.948	0.887	0.749	0.458	0.228	0.091
0.50	1.000	0.973	0.943	0.878	0.732	0.431	0.203	0.075
0.55	1.000	0.971	0.940	0.871	0.716	0.407	0.182	0.063
0.60	1.000	0.969	0.936	0.863	0.702	0.386	0.163	0.052
0.65	1.000	0.968	0.933	0.857	0.689	0.367	0.148	0.044
0.70	1.000	0.966	0.930	0.851	0.678	0.350	0.134	0.037
0.75	1.000	0.965	0.927	0.845	0.668	0.335	0.122	0.031
0.80	1.000	0.964	0.925	0.841	0.658	0.321	0.111	0.027
0.85	1.000	0.963	0.923	0.837	0.650	0.308	0.102	0.023
0.90	1.000	0.962	0.921	0.833	0.643	0.297	0.094	0.019
0.95	1.000	0.961	0.920	0.830	0.636	0.286	0.086	0.016
1.00	1.000	0.961	0.919	0.828	0.631	0.276	0.079	0.014
1.25	1.000	0.960	0.918	0.824	0.614	0.235	0.052	0.006
1.50	1.000	0.964	0.925	0.833	0.609	0.199	0.033	0.003
1.75	1.000	0.972	0.939	0.853	0.610	0.163	0.020	0.001
2.00	1.000	0.985	0.962	0.884	0.608	0.128	0.011	0.000
2.25	1.000	1.002	0.992	0.922	0.594	0.094	0.006	0.000
2.50	1.000	1.023	1.031	0.964	0.561	0.067	0.003	0.000
2.75	1.000	1.049	1.077	1.004	0.508	0.045	0.002	0.000
3.00	1.000	1.063	1.107	1.054	0.451	0.031	0.001	0.000
3.25	1.000	1.043	1.065	0.975	0.402	0.022	0.000	0.000
3.50	1.000	1.023	1.024	0.902	0.344	0.015	0.000	0.000
3.75	1.000	1.003	0.985	0.834	0.294	0.011	0.000	0.000
4.00	1.000	0.984	0.948	0.772	0.252	0.008	0.000	0.000
4.50	1.000	0.946	0.877	0.661	0.185	0.004	0.000	0.000
5.00	1.000	0.910	0.811	0.565	0.135	0.002	0.000	0.000
5.50	1.000	0.875	0.750	0.484	0.099	0.001	0.000	0.000
6.00	1.000	0.842	0.694	0.414	0.073	0.001	0.000	0.000
6.50	1.000	0.810	0.642	0.354	0.053	0.000	0.000	0.000
7.00	1.000	0.779	0.594	0.303	0.039	0.000	0.000	0.000
7.50	1.000	0.749	0.549	0.259	0.028	0.000	0.000	0.000
8.00	1.000	0.720	0.508	0.222	0.021	0.000	0.000	0.000
8.50	1.000	0.693	0.470	0.190	0.015	0.000	0.000	0.000
9.00	1.000	0.666	0.435	0.163	0.011	0.000	0.000	0.000
9.50	1.000	0.641	0.402	0.139	0.008	0.000	0.000	0.000
10.00	1.000	0.616	0.372	0.119	0.006	0.000	0.000	0.000

Note : All angles are in degree

Table 17

Kinetic energy of the incident proton beam is 18.00 GeV

Momentum		Sanford-Wang's Angular Dependence							
of		with							
secondary		kinematic reflection							
+ pion		production angle in laboratory frame							
<GeV/c>		0	1	2	4	8	16	24	32
0.30	1.000	1.118	1.244	1.497	1.844	1.663	1.202	0.851	
0.35	1.000	1.168	1.350	1.704	2.030	1.496	0.995	0.680	
0.40	1.000	1.228	1.480	1.932	2.075	1.242	0.793	0.533	
0.45	1.000	1.275	1.592	2.175	2.018	1.024	0.649	0.432	
0.50	1.000	1.269	1.578	2.137	1.951	0.885	0.565	0.374	
0.55	1.000	1.264	1.564	2.099	1.893	0.762	0.491	0.322	
0.60	1.000	1.258	1.550	2.063	1.818	0.660	0.427	0.276	
0.65	1.000	1.253	1.537	2.027	1.756	0.577	0.372	0.236	
0.70	1.000	1.247	1.523	1.992	1.695	0.511	0.326	0.202	
0.75	1.000	1.242	1.510	1.957	1.636	0.458	0.286	0.173	
0.80	1.000	1.236	1.497	1.923	1.580	0.413	0.252	0.148	
0.85	1.000	1.231	1.484	1.890	1.526	0.376	0.222	0.127	
0.90	1.000	1.225	1.471	1.857	1.473	0.344	0.196	0.108	
0.95	1.000	1.220	1.458	1.824	1.422	0.316	0.174	0.093	
1.00	1.000	1.215	1.445	1.793	1.373	0.292	0.154	0.079	
1.25	1.000	1.188	1.383	1.642	1.152	0.206	0.086	0.036	
1.50	1.000	1.163	1.324	1.504	0.966	0.145	0.049	0.016	
1.75	1.000	1.137	1.267	1.378	0.811	0.102	0.028	0.007	
2.00	1.000	1.113	1.212	1.262	0.680	0.072	0.016	0.003	
2.25	1.000	1.089	1.160	1.156	0.571	0.051	0.009	0.001	
2.50	1.000	1.065	1.111	1.059	0.479	0.036	0.005	0.001	
2.75	1.000	1.042	1.063	0.970	0.402	0.025	0.003	0.000	
3.00	1.000	1.019	1.017	0.888	0.337	0.018	0.002	0.000	
3.25	1.000	0.997	0.974	0.814	0.283	0.012	0.001	0.000	
3.50	1.000	0.975	0.932	0.745	0.237	0.009	0.001	0.000	
3.75	1.000	0.954	0.892	0.683	0.199	0.006	0.000	0.000	
4.00	1.000	0.934	0.853	0.625	0.167	0.004	0.000	0.000	
4.50	1.000	0.893	0.782	0.525	0.118	0.002	0.000	0.000	
5.00	1.000	0.855	0.716	0.440	0.083	0.001	0.000	0.000	
5.50	1.000	0.818	0.656	0.369	0.058	0.001	0.000	0.000	
6.00	1.000	0.783	0.601	0.310	0.041	0.000	0.000	0.000	
6.50	1.000	0.750	0.550	0.260	0.029	0.000	0.000	0.000	
7.00	1.000	0.717	0.504	0.218	0.020	0.000	0.000	0.000	
7.50	1.000	0.687	0.462	0.183	0.014	0.000	0.000	0.000	
8.00	1.000	0.657	0.423	0.154	0.010	0.000	0.000	0.000	
8.50	1.000	0.629	0.387	0.129	0.007	0.000	0.000	0.000	
9.00	1.000	0.602	0.355	0.108	0.005	0.000	0.000	0.000	
9.50	1.000	0.576	0.325	0.091	0.004	0.000	0.000	0.000	
10.00	1.000	0.551	0.298	0.076	0.002	0.000	0.000	0.000	

Note : All angles are in degree

Table 18

Kinetic energy of the incident proton beam is 18.00 GeV

Momentum Sanford-Wang's Angular Dependence
of with
 kinematic reflection

secondary								
- p/c	production angle in laboratory frame							
<GeV/c>	0	1	2	4	8	16	24	32
0.30	1.000	1.133	1.276	1.567	1.965	1.735	1.215	0.837
0.35	1.000	1.188	1.395	1.802	2.163	1.525	0.978	0.652
0.40	1.000	1.256	1.542	2.059	2.186	1.231	0.760	0.499
0.45	1.000	1.308	1.671	2.340	2.104	0.997	0.612	0.400
0.50	1.000	1.303	1.657	2.302	2.036	0.863	0.535	0.347
0.55	1.000	1.298	1.643	2.264	1.970	0.746	0.467	0.300
0.60	1.000	1.292	1.630	2.227	1.906	0.650	0.408	0.259
0.65	1.000	1.287	1.616	2.191	1.844	0.574	0.358	0.223
0.70	1.000	1.282	1.603	2.155	1.784	0.513	0.315	0.192
0.75	1.000	1.276	1.590	2.119	1.726	0.464	0.278	0.165
0.80	1.000	1.271	1.577	2.085	1.670	0.423	0.246	0.141
0.85	1.000	1.266	1.564	2.051	1.615	0.388	0.218	0.121
0.90	1.000	1.261	1.551	2.017	1.563	0.358	0.194	0.104
0.95	1.000	1.255	1.538	1.984	1.512	0.332	0.173	0.089
1.00	1.000	1.250	1.526	1.951	1.463	0.309	0.154	0.077
1.25	1.000	1.225	1.464	1.797	1.240	0.222	0.088	0.035
1.50	1.000	1.200	1.405	1.654	1.051	0.160	0.051	0.016
1.75	1.000	1.175	1.348	1.523	0.891	0.115	0.030	0.007
2.00	1.000	1.151	1.293	1.402	0.755	0.082	0.017	0.003
2.25	1.000	1.128	1.241	1.291	0.640	0.059	0.010	0.001
2.50	1.000	1.104	1.191	1.188	0.543	0.043	0.006	0.001
2.75	1.000	1.082	1.142	1.094	0.460	0.031	0.003	0.000
3.00	1.000	1.060	1.096	1.007	0.390	0.022	0.002	0.000
3.25	1.000	1.038	1.052	0.928	0.331	0.016	0.001	0.000
3.50	1.000	1.017	1.009	0.854	0.280	0.011	0.001	0.000
3.75	1.000	0.996	0.958	0.786	0.237	0.008	0.000	0.000
4.00	1.000	0.976	0.929	0.724	0.201	0.006	0.000	0.000
4.50	1.000	0.936	0.855	0.614	0.145	0.003	0.000	0.000
5.00	1.000	0.898	0.788	0.520	0.104	0.002	0.000	0.000
5.50	1.000	0.862	0.725	0.441	0.075	0.001	0.000	0.000
6.00	1.000	0.827	0.668	0.374	0.054	0.000	0.000	0.000
6.50	1.000	0.794	0.615	0.317	0.039	0.000	0.000	0.000
7.00	1.000	0.761	0.566	0.269	0.028	0.000	0.000	0.000
7.50	1.000	0.731	0.521	0.228	0.020	0.000	0.000	0.000
8.00	1.000	0.701	0.480	0.193	0.014	0.000	0.000	0.000
8.50	1.000	0.673	0.442	0.164	0.010	0.000	0.000	0.000
9.00	1.000	0.645	0.407	0.139	0.007	0.000	0.000	0.000
9.50	1.000	0.619	0.374	0.118	0.005	0.000	0.000	0.000
10.00	1.000	0.594	0.345	0.100	0.004	0.000	0.000	0.000

Note : All angles are in degree

Table 19

Kinetic energy of the incident proton beam is 18.00 GeV

Momentum Sanford-Wang's Angular Dependence
of with
 kinematic reflection

secondary -----

+ kaon production angle in laboratory frame

<GeV/c>	0	1	2	4	8	16	24	32
0.30	1.000	0.991	0.982	0.962	0.920	0.824	0.715	0.599
0.35	1.000	0.991	0.982	0.963	0.920	0.817	0.695	0.566
0.40	1.000	0.992	0.983	0.965	0.923	0.814	0.678	0.534
0.45	1.000	0.993	0.986	0.970	0.930	0.815	0.663	0.504
0.50	1.000	0.995	0.990	0.977	0.940	0.818	0.648	0.473
0.55	1.000	0.998	0.995	0.986	0.954	0.824	0.633	0.441
0.60	1.000	1.001	1.001	0.997	0.972	0.831	0.616	0.409
0.65	1.000	1.005	1.008	1.011	0.993	0.838	0.597	0.377
0.70	1.000	1.009	1.017	1.028	1.017	0.845	0.575	0.345
0.75	1.000	1.014	1.027	1.047	1.044	0.849	0.550	0.313
0.80	1.000	1.020	1.039	1.068	1.075	0.851	0.523	0.281
0.85	1.000	1.026	1.052	1.092	1.108	0.850	0.493	0.252
0.90	1.000	1.034	1.066	1.119	1.142	0.843	0.462	0.223
0.95	1.000	1.042	1.082	1.148	1.179	0.832	0.430	0.197
1.00	1.000	1.050	1.099	1.181	1.216	0.815	0.396	0.173
1.25	1.000	1.105	1.211	1.383	1.382	0.659	0.242	0.084
1.50	1.000	1.182	1.369	1.641	1.413	0.447	0.133	0.038
1.75	1.000	1.173	1.357	1.656	1.385	0.309	0.080	0.019
2.00	1.000	1.148	1.300	1.519	1.166	0.203	0.047	0.009
2.25	1.000	1.124	1.245	1.394	0.982	0.130	0.027	0.004
2.50	1.000	1.100	1.193	1.279	0.827	0.083	0.016	0.002
2.75	1.000	1.077	1.143	1.174	0.696	0.054	0.009	0.001
3.00	1.000	1.054	1.095	1.077	0.586	0.036	0.005	0.000
3.25	1.000	1.031	1.049	0.988	0.493	0.024	0.003	0.000
3.50	1.000	1.009	1.004	0.907	0.415	0.016	0.002	0.000
3.75	1.000	0.988	0.962	0.832	0.350	0.011	0.001	0.000
4.00	1.000	0.967	0.922	0.764	0.295	0.008	0.001	0.000
4.50	1.000	0.926	0.846	0.643	0.209	0.004	0.000	0.000
5.00	1.000	0.887	0.776	0.541	0.148	0.002	0.000	0.000
5.50	1.000	0.850	0.712	0.456	0.105	0.001	0.000	0.000
6.00	1.000	0.814	0.653	0.384	0.074	0.001	0.000	0.000
6.50	1.000	0.780	0.600	0.323	0.053	0.000	0.000	0.000
7.00	1.000	0.747	0.550	0.272	0.037	0.000	0.000	0.000
7.50	1.000	0.715	0.505	0.229	0.026	0.000	0.000	0.000
8.00	1.000	0.685	0.463	0.193	0.019	0.000	0.000	0.000
8.50	1.000	0.657	0.425	0.162	0.013	0.000	0.000	0.000
9.00	1.000	0.629	0.390	0.137	0.009	0.000	0.000	0.000
9.50	1.000	0.602	0.358	0.115	0.007	0.000	0.000	0.000
10.00	1.000	0.577	0.328	0.097	0.005	0.000	0.000	0.000

Note : All angles are in degree

Table 20

Kinetic energy of the incident proton beam is 18.00 GeV

Momentum Sanford-Wang's Angular Dependence
of with
 kinematic reflection

secondary -----

- kaon production angle in laboratory frame

<GeV/c>	0	1	2	4	8	16	24	32
0.30	1.030	0.989	0.977	0.952	0.893	0.749	0.587	0.427
0.35	1.000	0.989	0.977	0.950	0.888	0.733	0.557	0.388
0.40	1.000	0.989	0.977	0.950	0.886	0.721	0.532	0.353
0.45	1.000	0.990	0.978	0.952	0.888	0.713	0.510	0.322
0.50	1.000	0.991	0.980	0.956	0.892	0.708	0.489	0.293
0.55	1.000	0.992	0.983	0.961	0.899	0.705	0.469	0.266
0.60	1.000	0.994	0.987	0.969	0.909	0.702	0.448	0.240
0.65	1.000	0.997	0.993	0.978	0.922	0.700	0.427	0.215
0.70	1.000	1.000	0.999	0.990	0.937	0.696	0.405	0.192
0.75	1.000	1.004	1.006	1.003	0.954	0.690	0.381	0.170
0.80	1.000	1.008	1.015	1.018	0.972	0.682	0.357	0.149
0.85	1.000	1.013	1.024	1.035	0.991	0.671	0.332	0.130
0.90	1.000	1.019	1.035	1.054	1.011	0.656	0.306	0.113
0.95	1.000	1.025	1.047	1.075	1.031	0.637	0.280	0.097
1.00	1.000	1.031	1.060	1.097	1.049	0.614	0.255	0.084
1.25	1.000	1.070	1.142	1.211	1.099	0.461	0.148	0.036
1.50	1.000	1.132	1.256	1.374	1.016	0.301	0.079	0.015
1.75	1.000	1.121	1.235	1.337	0.848	0.192	0.043	0.006
2.00	1.000	1.098	1.185	1.233	0.721	0.121	0.023	0.002
2.25	1.000	1.076	1.138	1.136	0.612	0.079	0.012	0.001
2.50	1.000	1.055	1.093	1.047	0.520	0.052	0.006	0.000
2.75	1.000	1.033	1.049	0.965	0.442	0.036	0.003	0.000
3.00	1.000	1.012	1.007	0.890	0.375	0.025	0.002	0.000
3.25	1.000	0.992	0.967	0.820	0.319	0.018	0.001	0.000
3.50	1.000	0.972	0.928	0.756	0.271	0.013	0.001	0.000
3.75	1.000	0.952	0.891	0.696	0.230	0.009	0.000	0.000
4.00	1.000	0.933	0.855	0.642	0.195	0.007	0.000	0.000
4.50	1.000	0.896	0.788	0.545	0.141	0.003	0.000	0.000
5.00	1.000	0.860	0.727	0.463	0.102	0.002	0.000	0.000
5.50	1.000	0.826	0.670	0.394	0.073	0.001	0.000	0.000
6.00	1.000	0.793	0.617	0.334	0.053	0.000	0.000	0.000
6.50	1.000	0.761	0.569	0.284	0.038	0.000	0.000	0.000
7.00	1.000	0.731	0.524	0.241	0.028	0.000	0.000	0.000
7.50	1.000	0.701	0.483	0.205	0.020	0.000	0.000	0.000
8.00	1.000	0.673	0.445	0.174	0.014	0.000	0.000	0.000
8.50	1.000	0.646	0.411	0.148	0.010	0.000	0.000	0.000
9.00	1.000	0.621	0.378	0.126	0.007	0.000	0.000	0.000
9.50	1.000	0.596	0.349	0.107	0.005	0.000	0.000	0.000
10.00	1.000	0.572	0.321	0.091	0.004	0.000	0.000	0.000

Note : All angles are in degree

Table 21

Kinetic energy of the incident proton is 24.00 GEV

Momentum of secondary antiproton <GeV/c>	Zero Degree Production (sr·GeV/c) ⁻¹	
	Sanford-Wang's formula with kinematic reflection	Yamamoto's formula
0.30	0.232377E-07	0.306608E-07
0.35	0.765277E-07	0.120084E-06
0.40	0.218631E-06	0.376034E-06
0.45	0.554102E-06	0.992769E-06
0.50	0.126760E-05	0.229201E-05
0.55	0.265390E-05	0.474978E-05
0.60	0.514383E-05	0.900936E-05
0.65	0.931903E-05	0.158760E-04
0.70	0.159105E-04	0.262943E-04
0.75	0.257814E-04	0.413120E-04
0.80	0.398915E-04	0.620347E-04
0.85	0.592516E-04	0.895783E-04
0.90	0.848717E-04	0.125021E-03
0.95	0.117716E-03	0.169365E-03
1.00	0.158645E-03	0.223499E-03
1.25	0.504524E-03	0.661793E-03
1.50	0.109364E-02	0.139171E-02
1.75	0.187708E-02	0.236904E-02
2.00	0.277675E-02	0.350908E-02
2.25	0.372209E-02	0.472033E-02
2.50	0.466294E-02	0.592341E-02
2.75	0.556832E-02	0.705704E-02
3.00	0.642186E-02	0.807440E-02
3.25	0.721673E-02	0.896101E-02
3.50	0.778827E-02	0.969083E-02
3.75	0.815887E-02	0.102640E-01
4.00	0.843959E-02	0.106826E-01
4.50	0.873226E-02	0.110930E-01
5.00	0.868881E-02	0.110156E-01
5.50	0.835731E-02	0.105625E-01
6.00	0.780053E-02	0.984319E-02
6.50	0.708642E-02	0.895455E-02
7.00	0.628049E-02	0.797723E-02
7.50	0.544057E-02	0.697472E-02
8.00	0.461367E-02	0.599439E-02
8.50	0.383487E-02	0.506989E-02
9.00	0.312766E-02	0.422293E-02
9.50	0.250521E-02	0.346572E-02
10.00	0.197218E-02	0.280305E-02

Table 22

Kinetic energy of the incident proton is 24.00 GEV

Momentum of secondary positive pion <GeV/c>	Zero Degree Production (sr, GeV/c) ⁻¹	
	Sanford-Wang's formula with kinematic reflection	Yamamoto's formula
0.30	0.309110E+00	0.266836E+00
0.35	0.393547E+00	0.322214E+00
0.40	0.483670E+00	0.376561E+00
0.45	0.579374E+00	0.429832E+00
0.50	0.679583E+00	0.482033E+00
0.55	0.720475E+00	0.533190E+00
0.60	0.759695E+00	0.583330E+00
0.65	0.797401E+00	0.632482E+00
0.70	0.833725E+00	0.680675E+00
0.75	0.868775E+00	0.727928E+00
0.80	0.902643E+00	0.774265E+00
0.85	0.935410E+00	0.819707E+00
0.90	0.967143E+00	0.864268E+00
0.95	0.997901E+00	0.907967E+00
1.00	0.102774E+01	0.950821E+00
1.25	0.116457E+01	0.115275E+01
1.50	0.128367E+01	0.133520E+01
1.75	0.138778E+01	0.149931E+01
2.00	0.147882E+01	0.164614E+01
2.25	0.155819E+01	0.177664E+01
2.50	0.162701E+01	0.189173E+01
2.75	0.168617E+01	0.199227E+01
3.00	0.173643E+01	0.207909E+01
3.25	0.177846E+01	0.215301E+01
3.50	0.181283E+01	0.221473E+01
3.75	0.184009E+01	0.226508E+01
4.00	0.186071E+01	0.230409E+01
4.50	0.188384E+01	0.235454E+01
5.00	0.188551E+01	0.236955E+01
5.50	0.186867E+01	0.235443E+01
6.00	0.183600E+01	0.231371E+01
6.50	0.178598E+01	0.225145E+01
7.00	0.173285E+01	0.217142E+01
7.50	0.166669E+01	0.207706E+01
8.00	0.159338E+01	0.197145E+01
8.50	0.151465E+01	0.185750E+01
9.00	0.143204E+01	0.173770E+01
9.50	0.134695E+01	0.161434E+01
10.00	0.126061E+01	0.148942E+01

Table 23

Kinetic energy of the incident proton is 24.00 GEV

Momentum of secondary negative pion <GeV/c>	Zero Degree Production (sr·GeV/c) ⁻¹	
	Sanford-Wang's formula with kinematic reflection	Yamamoto's formula
0.30	0.237848E+00	0.236665E+00
0.35	0.308170E+00	0.286876E+00
0.40	0.384639E+00	0.336013E+00
0.45	0.467164E+00	0.383978E+00
0.50	0.554641E+00	0.430747E+00
0.55	0.581337E+00	0.476326E+00
0.60	0.606606E+00	0.520732E+00
0.65	0.630601E+00	0.563988E+00
0.70	0.653443E+00	0.606120E+00
0.75	0.675236E+00	0.647149E+00
0.80	0.696064E+00	0.687099E+00
0.85	0.716000E+00	0.725993E+00
0.90	0.735106E+00	0.763851E+00
0.95	0.753437E+00	0.800695E+00
1.00	0.771040E+00	0.836547E+00
1.25	0.849426E+00	0.100143E+01
1.50	0.914270E+00	0.114391E+01
1.75	0.967948E+00	0.126579E+01
2.00	0.101208E+01	0.136875E+01
2.25	0.104784E+01	0.145431E+01
2.50	0.107617E+01	0.152391E+01
2.75	0.109780E+01	0.157890E+01
3.00	0.111337E+01	0.162056E+01
3.25	0.112342E+01	0.165008E+01
3.50	0.112846E+01	0.166854E+01
3.75	0.112893E+01	0.167707E+01
4.00	0.112522E+01	0.167657E+01
4.50	0.110680E+01	0.165230E+01
5.00	0.107596E+01	0.160250E+01
5.50	0.103515E+01	0.153298E+01
6.00	0.986561E+00	0.144889E+01
6.50	0.932170E+00	0.135458E+01
7.00	0.873723E+00	0.125377E+01
7.50	0.812768E+00	0.114961E+01
8.00	0.750651E+00	0.104467E+01
8.50	0.688525E+00	0.941161E+00
9.00	0.627362E+00	0.840724E+00
9.50	0.567964E+00	0.744719E+00
10.00	0.510968E+00	0.654128E+00

Table 24

Kinetic energy of the incident proton is 24.00 GEV

Momentum of secondary positive kaon <GeV/c>	Zero Degree Production (sr·GeV/c) ⁻¹	
	Sanford-Wang's formula with kinematic reflection	Yamamoto's formula
0.30	0.318171E-02	0.383996E-02
0.35	0.445205E-02	0.557990E-02
0.40	0.589925E-02	0.762713E-02
0.45	0.750222E-02	0.994414E-02
0.50	0.924202E-02	0.124903E-01
0.55	0.111024E-01	0.152260E-01
0.60	0.130695E-01	0.181145E-01
0.65	0.151322E-01	0.211235E-01
0.70	0.172812E-01	0.242250E-01
0.75	0.195091E-01	0.273952E-01
0.80	0.218095E-01	0.306141E-01
0.85	0.241777E-01	0.338654E-01
0.90	0.266096E-01	0.371351E-01
0.95	0.291018E-01	0.404119E-01
1.00	0.316518E-01	0.436865E-01
1.25	0.452042E-01	0.597977E-01
1.50	0.600052E-01	0.751255E-01
1.75	0.760155E-01	0.894438E-01
2.00	0.831309E-01	0.102677E+00
2.25	0.891948E-01	0.114811E+00
2.50	0.948665E-01	0.125866E+00
2.75	0.100183E+00	0.135871E+00
3.00	0.105171E+00	0.144865E+00
3.25	0.109854E+00	0.152889E+00
3.50	0.114248E+00	0.159984E+00
3.75	0.118367E+00	0.166194E+00
4.00	0.122222E+00	0.171560E+00
4.50	0.129174E+00	0.179930E+00
5.00	0.135146E+00	0.185417E+00
5.50	0.140156E+00	0.188331E+00
6.00	0.144202E+00	0.188965E+00
6.50	0.147265E+00	0.187599E+00
7.00	0.149315E+00	0.184492E+00
7.50	0.150317E+00	0.179889E+00
8.00	0.150228E+00	0.174023E+00
8.50	0.149012E+00	0.167108E+00
9.00	0.146637E+00	0.159325E+00
9.50	0.143085E+00	0.150878E+00
10.00	0.138358E+00	0.141933E+00

Table 25

Kinetic energy of the incident proton is 24.00 GeV

Momentum cf secondary negative kaon <GeV/c>	Zero Degree Production (sr·GeV/c) ⁻¹	
	Sanford-Wang's formula with kinematic reflection	Yamamoto's formula
0.30	0.103426E-02	0.992666E-03
0.35	0.165655E-02	0.159961E-02
0.40	0.244408E-02	0.238547E-02
0.45	0.338313E-02	0.334809E-02
0.50	0.445330E-02	0.447747E-02
0.55	0.563157E-02	0.575854E-02
0.60	0.689510E-02	0.717326E-02
0.65	0.822309E-02	0.870274E-02
0.70	0.959745E-02	0.103282E-01
0.75	0.110032E-01	0.120316E-01
0.80	0.124281E-01	0.137967E-01
0.85	0.138626E-01	0.156088E-01
0.90	0.152993E-01	0.174546E-01
0.95	0.167324E-01	0.193223E-01
1.00	0.181579E-01	0.212022E-01
1.25	0.250924E-01	0.305125E-01
1.50	0.316517E-01	0.392235E-01
1.75	0.378773E-01	0.470094E-01
2.00	0.432999E-01	0.537515E-01
2.25	0.482833E-01	0.594335E-01
2.50	0.527995E-01	0.640920E-01
2.75	0.568049E-01	0.677883E-01
3.00	0.602706E-01	0.705971E-01
3.25	0.631801E-01	0.725979E-01
3.50	0.655288E-01	0.738686E-01
3.75	0.673212E-01	0.744874E-01
4.00	0.685713E-01	0.745277E-01
4.50	0.695339E-01	0.731497E-01
5.00	0.686498E-01	0.702367E-01
5.50	0.662134E-01	0.662214E-01
6.00	0.625490E-01	0.614645E-01
6.50	0.579841E-01	0.562630E-01
7.00	0.528297E-01	0.508577E-01
7.50	0.473652E-01	0.454378E-01
8.00	0.418300E-01	0.401511E-01
8.50	0.364182E-01	0.351062E-01
9.00	0.312785E-01	0.303741E-01
9.50	0.265168E-01	0.260144E-01
10.00	0.221997E-01	0.220543E-01

Table 26

Kinetic energy of the incident proton beam is 24.00 GeV

Momentum		Sanford-Wang's Angular Dependence							
of		with							
secondary		kinematic reflection							
antiproton		production angle in laboratory frame							
<GeV/c>		0	1	2	4	8	16	24	32
0.30	1.000	0.982	0.962	0.916	0.806	0.554	0.324	0.162	
0.35	1.000	0.980	0.957	0.905	0.784	0.514	0.282	0.129	
0.40	1.000	0.977	0.952	0.895	0.764	0.480	0.247	0.104	
0.45	1.000	0.975	0.947	0.886	0.745	0.449	0.218	0.084	
0.50	1.000	0.973	0.943	0.877	0.728	0.422	0.193	0.069	
0.55	1.000	0.971	0.939	0.869	0.712	0.398	0.173	0.057	
0.60	1.000	0.969	0.936	0.862	0.698	0.377	0.155	0.048	
0.65	1.000	0.968	0.932	0.855	0.685	0.358	0.140	0.040	
0.70	1.000	0.966	0.929	0.849	0.674	0.341	0.127	0.034	
0.75	1.000	0.965	0.927	0.844	0.663	0.326	0.115	0.028	
0.80	1.000	0.964	0.924	0.839	0.654	0.313	0.105	0.024	
0.85	1.000	0.963	0.922	0.835	0.646	0.300	0.096	0.020	
0.90	1.000	0.962	0.921	0.831	0.639	0.289	0.088	0.017	
0.95	1.000	0.961	0.919	0.828	0.632	0.279	0.081	0.015	
1.00	1.000	0.960	0.918	0.826	0.627	0.270	0.075	0.013	
1.25	1.000	0.960	0.917	0.822	0.611	0.233	0.050	0.006	
1.50	1.000	0.964	0.924	0.832	0.611	0.203	0.033	0.002	
1.75	1.000	0.972	0.938	0.854	0.621	0.176	0.021	0.001	
2.00	1.000	0.984	0.961	0.888	0.635	0.147	0.013	0.000	
2.25	1.000	1.001	0.992	0.933	0.648	0.119	0.007	0.000	
2.50	1.000	1.022	1.032	0.988	0.650	0.092	0.004	0.000	
2.75	1.000	1.048	1.080	1.051	0.636	0.068	0.002	0.000	
3.00	1.000	1.079	1.138	1.115	0.601	0.049	0.001	0.000	
3.25	1.000	1.116	1.205	1.177	0.546	0.034	0.001	0.000	
3.50	1.000	1.123	1.227	1.234	0.485	0.024	0.000	0.000	
3.75	1.000	1.101	1.180	1.141	0.423	0.016	0.000	0.000	
4.00	1.000	1.080	1.135	1.056	0.359	0.011	0.000	0.000	
4.50	1.000	1.039	1.050	0.904	0.263	0.005	0.000	0.000	
5.00	1.000	0.999	0.972	0.773	0.192	0.003	0.000	0.000	
5.50	1.000	0.961	0.899	0.662	0.141	0.001	0.000	0.000	
6.00	1.000	0.924	0.831	0.566	0.103	0.001	0.000	0.000	
6.50	1.000	0.889	0.769	0.485	0.076	0.000	0.000	0.000	
7.00	1.000	0.855	0.712	0.415	0.055	0.000	0.000	0.000	
7.50	1.000	0.822	0.658	0.355	0.041	0.000	0.000	0.000	
8.00	1.000	0.791	0.609	0.304	0.030	0.000	0.000	0.000	
8.50	1.000	0.761	0.563	0.260	0.022	0.000	0.000	0.000	
9.00	1.000	0.732	0.521	0.222	0.016	0.000	0.000	0.000	
9.50	1.000	0.704	0.482	0.190	0.012	0.000	0.000	0.000	
10.00	1.000	0.677	0.446	0.163	0.009	0.000	0.000	0.000	

Note : All angles are in degree

Table 27

Kinetic energy of the incident proton beam is 24.00 GeV

Momentum Sanford-Wang's Angular Dependence
of With
 kinematic reflection

secondary -----

+ pion production angle in laboratory frame

<GeV/c>	0	1	2	4	8	16	24	32
0.30	1.000	1.118	1.244	1.510	1.957	2.029	1.546	1.078
0.35	1.000	1.167	1.352	1.740	2.297	2.055	1.409	0.920
0.40	1.000	1.227	1.485	2.020	2.582	1.924	1.224	0.763
0.45	1.000	1.299	1.649	2.338	2.724	1.691	1.032	0.624
0.50	1.000	1.388	1.848	2.669	2.672	1.426	0.858	0.507
0.55	1.000	1.382	1.859	2.825	2.655	1.280	0.773	0.447
0.60	1.000	1.376	1.842	2.776	2.513	1.130	0.689	0.391
0.65	1.000	1.370	1.826	2.727	2.426	0.991	0.612	0.340
0.70	1.000	1.364	1.810	2.680	2.343	0.869	0.543	0.295
0.75	1.000	1.358	1.794	2.633	2.262	0.765	0.481	0.255
0.80	1.000	1.352	1.779	2.588	2.184	0.676	0.426	0.220
0.85	1.000	1.346	1.763	2.543	2.108	0.601	0.377	0.189
0.90	1.000	1.340	1.748	2.498	2.036	0.538	0.334	0.163
0.95	1.000	1.335	1.732	2.455	1.965	0.483	0.297	0.140
1.00	1.000	1.329	1.717	2.412	1.898	0.436	0.263	0.120
1.25	1.000	1.300	1.644	2.209	1.592	0.274	0.146	0.055
1.50	1.000	1.272	1.573	2.024	1.336	0.182	0.082	0.025
1.75	1.000	1.244	1.505	1.854	1.121	0.123	0.046	0.011
2.00	1.000	1.217	1.441	1.698	0.940	0.085	0.026	0.005
2.25	1.000	1.191	1.379	1.555	0.789	0.059	0.015	0.002
2.50	1.000	1.165	1.320	1.425	0.662	0.041	0.008	0.001
2.75	1.000	1.139	1.263	1.305	0.555	0.028	0.005	0.000
3.00	1.000	1.115	1.209	1.195	0.466	0.020	0.003	0.000
3.25	1.000	1.091	1.157	1.095	0.391	0.014	0.001	0.000
3.50	1.000	1.067	1.107	1.003	0.328	0.010	0.001	0.000
3.75	1.000	1.044	1.060	0.919	0.275	0.007	0.000	0.000
4.00	1.000	1.021	1.014	0.841	0.231	0.005	0.000	0.000
4.50	1.000	0.977	0.929	0.706	0.163	0.002	0.000	0.000
5.00	1.000	0.935	0.851	0.592	0.114	0.001	0.000	0.000
5.50	1.000	0.895	0.779	0.497	0.081	0.001	0.000	0.000
6.00	1.000	0.857	0.714	0.417	0.057	0.000	0.000	0.000
6.50	1.000	0.820	0.654	0.350	0.040	0.000	0.000	0.000
7.00	1.000	0.785	0.599	0.293	0.028	0.000	0.000	0.000
7.50	1.000	0.751	0.549	0.246	0.020	0.000	0.000	0.000
8.00	1.000	0.719	0.503	0.207	0.014	0.000	0.000	0.000
8.50	1.000	0.688	0.460	0.173	0.010	0.000	0.000	0.000
9.00	1.000	0.658	0.422	0.145	0.007	0.000	0.000	0.000
9.50	1.000	0.630	0.386	0.122	0.005	0.000	0.000	0.000
10.00	1.000	0.603	0.354	0.102	0.003	0.000	0.000	0.000

Note : All angles are in degree

Table 28

Kinetic energy of the incident proton beam is 24.00 GeV

Momentum Sanford-Wang's Angular Dependence
of with
 kinematic reflection

secondary -----

- pion production angle in laboratory frame

<GeV/c>	0	1	2	4	8	16	24	32
0.30	1.000	1.132	1.276	1.582	2.104	2.175	1.613	1.091
0.35	1.000	1.187	1.397	1.846	2.491	2.178	1.444	0.913
0.40	1.000	1.254	1.549	2.169	2.804	1.999	1.228	0.743
0.45	1.000	1.335	1.736	2.534	2.934	1.715	1.013	0.596
0.50	1.000	1.435	1.964	2.911	2.830	1.411	0.826	0.475
0.55	1.000	1.430	1.980	3.110	2.810	1.264	0.745	0.422
0.60	1.000	1.424	1.964	3.059	2.653	1.114	0.667	0.371
0.65	1.000	1.418	1.948	3.008	2.567	0.977	0.594	0.324
0.70	1.000	1.412	1.932	2.959	2.483	0.857	0.528	0.282
0.75	1.000	1.407	1.916	2.911	2.402	0.756	0.469	0.244
0.80	1.000	1.401	1.900	2.863	2.324	0.671	0.417	0.212
0.85	1.000	1.395	1.885	2.816	2.249	0.599	0.371	0.183
0.90	1.000	1.389	1.869	2.770	2.176	0.537	0.330	0.158
0.95	1.000	1.383	1.854	2.724	2.105	0.485	0.294	0.136
1.00	1.000	1.378	1.838	2.680	2.036	0.440	0.262	0.117
1.25	1.000	1.350	1.764	2.467	1.726	0.284	0.148	0.054
1.50	1.000	1.322	1.693	2.272	1.463	0.193	0.085	0.025
1.75	1.000	1.295	1.624	2.091	1.240	0.134	0.049	0.011
2.00	1.000	1.268	1.558	1.925	1.051	0.094	0.028	0.005
2.25	1.000	1.243	1.495	1.773	0.891	0.067	0.016	0.002
2.50	1.000	1.217	1.435	1.632	0.755	0.047	0.009	0.001
2.75	1.000	1.192	1.377	1.503	0.640	0.034	0.005	0.000
3.00	1.000	1.168	1.321	1.383	0.543	0.024	0.003	0.000
3.25	1.000	1.144	1.267	1.274	0.460	0.017	0.002	0.000
3.50	1.000	1.121	1.216	1.173	0.390	0.012	0.001	0.000
3.75	1.000	1.098	1.167	1.080	0.331	0.009	0.000	0.000
4.00	1.000	1.075	1.120	0.994	0.280	0.006	0.000	0.000
4.50	1.000	1.032	1.031	0.843	0.201	0.003	0.000	0.000
5.00	1.000	0.990	0.949	0.714	0.145	0.002	0.000	0.000
5.50	1.000	0.950	0.874	0.605	0.104	0.001	0.000	0.000
6.00	1.000	0.911	0.805	0.513	0.075	0.000	0.000	0.000
6.50	1.000	0.875	0.741	0.435	0.054	0.000	0.000	0.000
7.00	1.000	0.839	0.682	0.369	0.039	0.000	0.000	0.000
7.50	1.000	0.805	0.628	0.313	0.028	0.000	0.000	0.000
8.00	1.000	0.773	0.578	0.265	0.020	0.000	0.000	0.000
8.50	1.000	0.741	0.532	0.225	0.014	0.000	0.000	0.000
9.00	1.000	0.711	0.490	0.190	0.010	0.000	0.000	0.000
9.50	1.000	0.683	0.451	0.161	0.007	0.000	0.000	0.000
10.00	1.000	0.655	0.415	0.137	0.005	0.000	0.000	0.000

Note : All angles are in degree

Table 29

Kinetic energy of the incident proton beam is 24.00 GeV

Momentum Sanford-Wang's Angular Dependence
of with
 kinematic reflection

secondary -----

+ kaon production angle in laboratory frame

<GeV/c>	0	1	2	4	8	16	24	32
0.30	1.000	0.991	0.981	0.962	0.920	0.824	0.715	0.599
0.35	1.000	0.991	0.982	0.962	0.920	0.817	0.696	0.567
0.40	1.000	0.992	0.983	0.965	0.923	0.815	0.681	0.538
0.45	1.000	0.993	0.986	0.970	0.930	0.817	0.668	0.509
0.50	1.000	0.995	0.990	0.977	0.941	0.822	0.656	0.481
0.55	1.000	0.998	0.995	0.986	0.955	0.831	0.645	0.453
0.60	1.000	1.001	1.001	0.997	0.974	0.842	0.633	0.425
0.65	1.000	1.005	1.008	1.011	0.996	0.854	0.620	0.396
0.70	1.000	1.009	1.017	1.028	1.021	0.867	0.605	0.367
0.75	1.000	1.014	1.027	1.047	1.051	0.881	0.587	0.337
0.80	1.000	1.020	1.038	1.069	1.085	0.893	0.568	0.308
0.85	1.000	1.026	1.051	1.093	1.122	0.904	0.546	0.280
0.90	1.000	1.033	1.065	1.121	1.162	0.913	0.522	0.253
0.95	1.000	1.041	1.081	1.151	1.206	0.918	0.496	0.227
1.00	1.000	1.050	1.099	1.185	1.253	0.919	0.468	0.203
1.25	1.000	1.104	1.211	1.402	1.515	0.856	0.324	0.108
1.50	1.000	1.180	1.372	1.708	1.747	0.692	0.201	0.053
1.75	1.000	1.281	1.593	2.091	1.816	0.495	0.117	0.025
2.00	1.000	1.267	1.576	2.159	1.848	0.366	0.073	0.012
2.25	1.000	1.240	1.510	1.981	1.596	0.257	0.045	0.006
2.50	1.000	1.214	1.446	1.818	1.344	0.175	0.027	0.003
2.75	1.000	1.188	1.385	1.668	1.131	0.117	0.016	0.001
3.00	1.000	1.163	1.327	1.530	0.953	0.079	0.009	0.001
3.25	1.000	1.138	1.271	1.404	0.802	0.053	0.005	0.000
3.50	1.000	1.114	1.218	1.289	0.675	0.035	0.003	0.000
3.75	1.000	1.090	1.166	1.182	0.569	0.024	0.002	0.000
4.00	1.000	1.067	1.117	1.085	0.479	0.016	0.001	0.000
4.50	1.000	1.022	1.025	0.913	0.339	0.008	0.000	0.000
5.00	1.000	0.979	0.941	0.769	0.241	0.004	0.000	0.000
5.50	1.000	0.938	0.863	0.648	0.171	0.002	0.000	0.000
6.00	1.000	0.898	0.792	0.545	0.121	0.001	0.000	0.000
6.50	1.000	0.860	0.727	0.459	0.086	0.000	0.000	0.000
7.00	1.000	0.824	0.667	0.387	0.061	0.000	0.000	0.000
7.50	1.000	0.790	0.612	0.325	0.043	0.000	0.000	0.000
8.00	1.000	0.756	0.562	0.274	0.031	0.000	0.000	0.000
8.50	1.000	0.725	0.515	0.231	0.022	0.000	0.000	0.000
9.00	1.000	0.694	0.473	0.194	0.015	0.000	0.000	0.000
9.50	1.000	0.665	0.434	0.164	0.011	0.000	0.000	0.000
10.00	1.000	0.637	0.398	0.138	0.008	0.000	0.000	0.000

Note : All angles are in degree

Table 30

Kinetic energy of the incident proton beam is 24.00 GeV

Momentum Sanford-Wang's Angular Dependence
of with
 kinematic reflection

secondary -----

- kaon production angle in laboratory frame

<GeV/c>	0	1	2	4	8	16	24	32
0.30	1.000	0.989	0.977	0.952	0.893	0.748	0.535	0.426
0.35	1.000	0.989	0.977	0.950	0.889	0.733	0.556	0.387
0.40	1.000	0.989	0.977	0.950	0.886	0.722	0.533	0.354
0.45	1.000	0.989	0.978	0.952	0.888	0.715	0.512	0.324
0.50	1.000	0.991	0.980	0.956	0.892	0.711	0.494	0.297
0.55	1.000	0.992	0.983	0.961	0.900	0.711	0.477	0.272
0.60	1.000	0.994	0.987	0.969	0.911	0.712	0.461	0.248
0.65	1.000	0.997	0.993	0.979	0.925	0.714	0.445	0.226
0.70	1.000	1.000	0.999	0.990	0.942	0.717	0.428	0.204
0.75	1.000	1.004	1.006	1.004	0.961	0.719	0.410	0.184
0.80	1.000	1.008	1.014	1.019	0.983	0.721	0.390	0.164
0.85	1.000	1.013	1.024	1.037	1.007	0.720	0.370	0.146
0.90	1.000	1.018	1.035	1.057	1.033	0.718	0.349	0.129
0.95	1.000	1.024	1.046	1.078	1.060	0.712	0.328	0.113
1.00	1.000	1.031	1.059	1.102	1.088	0.704	0.306	0.099
1.25	1.000	1.073	1.143	1.253	1.226	0.611	0.200	0.047
1.50	1.000	1.131	1.261	1.447	1.289	0.464	0.119	0.020
1.75	1.000	1.208	1.416	1.652	1.206	0.319	0.067	0.008
2.00	1.000	1.192	1.388	1.621	1.005	0.211	0.036	0.003
2.25	1.000	1.168	1.332	1.494	0.835	0.137	0.020	0.001
2.50	1.000	1.144	1.279	1.377	0.709	0.089	0.010	0.000
2.75	1.000	1.121	1.228	1.269	0.603	0.058	0.005	0.000
3.00	1.000	1.099	1.179	1.169	0.512	0.039	0.003	0.000
3.25	1.000	1.076	1.132	1.078	0.435	0.026	0.001	0.000
3.50	1.000	1.055	1.086	0.993	0.369	0.018	0.001	0.000
3.75	1.000	1.033	1.043	0.916	0.314	0.012	0.000	0.000
4.00	1.000	1.013	1.001	0.844	0.267	0.008	0.000	0.000
4.50	1.000	0.972	0.923	0.717	0.192	0.004	0.000	0.000
5.00	1.000	0.933	0.851	0.609	0.139	0.002	0.000	0.000
5.50	1.000	0.896	0.784	0.517	0.100	0.001	0.000	0.000
6.00	1.000	0.860	0.723	0.439	0.072	0.000	0.000	0.000
6.50	1.000	0.826	0.666	0.373	0.052	0.000	0.000	0.000
7.00	1.000	0.793	0.614	0.317	0.038	0.000	0.000	0.000
7.50	1.000	0.761	0.566	0.269	0.027	0.000	0.000	0.000
8.00	1.000	0.731	0.521	0.229	0.020	0.000	0.000	0.000
8.50	1.000	0.701	0.481	0.194	0.014	0.000	0.000	0.000
9.00	1.000	0.673	0.443	0.165	0.010	0.000	0.000	0.000
9.50	1.000	0.647	0.408	0.140	0.007	0.000	0.000	0.000
10.00	1.000	0.621	0.376	0.119	0.005	0.000	0.000	0.000

Note : All angles are in degree